OPERATIVE SURGERY.

BY

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PREFACE.

The following Work was undertaken in compliance with the advice of some professional friends, who equally felt with myself the want of a book on the subject of Operative Surgery, which might become, not simply a guide to the actual operation, and embrace the practical rules required to justify the appeal to the knife, but would embody, at the same time, such principles as should constitute a permanent guide to the practitioner of Operative Surgery, and without which, all claim to its scientific character is lost.

As in the pursuits of practical surgery, the knowledge of "principles" exceeds greatly in value that of the details of practice, because the principles form the rule of conduct, and the practice the deduction, so a knowledge of the principles of Operative Surgery, which ought to regulate the conduct of the surgeon in undertaking even the least critical forms of operation, is all important as the guide and load-star of our conduct. It is a consideration of far less moment, in what manner an operation be performed, provided it be executed with safety, than is the previous decision of its actual necessity. The question of appeal to the knife involves the principle, its employment, the practice of Operative Surgery. In no department of professional duty are the rules of conduct so imperative as in that which proposes the removal of a portion of the body, or the exposure of its internal structure, by instrumental agency, because

the effect of local violence is always felt as a blow to the integrity of the frame, although the operation itself, thanks to a great modern discovery, may be rendered painless.

To write a work on Operative Surgery, which should consist of merely mechanical rules for the performance of an amputation, for example, would be to leave the work more than half unfinished, simply because the knowledge, which determines the necessity of the undertaking, is far more valuable, and far more difficult of attainment, than that which is required to qualify a surgeon for its performance. The one qualification involves both the moral feeling and the intellect of the surgeon. The other demands the exercise of his physical functions only.

I hope to see this essential department of medicine occupying its just position, a position neither too exalted nor too low, in the esteem of the profession. To elevate it from this rank by attaching to it a value beyond its absolute worth is to carry ourselves back into the past; to depreciate its value is to exhibit an ill-judged reliance on remedies notoriously incompetent to cure. The first extreme argues a low appreciation of the value of human life, by the indulgence in uncalled-for experimentalization, and recklessness of human suffering; the second betrays an unpardonable ignorance of the resources of this important department of medicine, and would award to the possessor of the highest qualities of the operator nothing beyond the dexterous manipulation of a mechanic. Each extreme argues ignorance of Nature, her power, and her laws.

The moral feeling of the operating surgeon is more involved in the establishment of a just reputation, than the world at large imagines, at least, if it be required that both the design and the execution of an operation devolve on his single responsibility. A surgeon may be required to step in between life and death; to venture on a large and speculative operation as the only alternative to certain

death; and under no condition is it more important that he protect the high name of his profession from the obloquy that so commonly attaches to failure, by extending to the case all the knowledge that can be acquired, by weighing the liabilities in his own scale, and by not yielding his judgment into the hands of those, who, less competent than himself to calculate the danger of the undertaking, and less responsible for the consequences of failure, would urge him on to resort to such means as prudence would justly repudiate.

These are the class of cases that test the moral tone, as well as the professional competency, of the surgeon, because success depends less on the power to manipulate than on the knowledge of the vital forces involved in the economy, and no less on his possession of judgment, and honor, and a spirit of independence, by which "he may the better judge;" attributes that should maintain him above such influence as would render him a mere instrument in the hands of others less competent than himself to foretell the consequences of a rash appeal to an uncalled-for and dangerous agency. It may be urged, in furtherance of the proposition, that death is certain without it, and that an operation cannot add to the difficulties that already surround the case. But this argument, though plausible, should only be admitted on the fullest consideration of its applicability. It appears reasonable enough to propose an operation—I might almost say, any operation—as an alternative, when death is the only and the certain condition of its non-performance.

I would go as far as any man in the effort to restore a life jeopardized by disease, so long as the chance of benefit would more than balance the consequences of failure. But it must not be forgotten that the interests of Operative Surgery invariably suffer from unsuccessful, and still more from fatal operations; that, under the most promising con-

dition, human nature shrinks from its appeal with fear and revulsion, and that failure in one case will probably deter many from submitting to operations which offer results far more encouraging. There is no eclat, no grandeur in a large surgical operation, but that which it derives from its success. The admiration of its performance, however well executed, is restricted to the limited circle witnessing it; the failure and consequent death of the victim become the property of rumor, with her hundred tongues, which proclaim to the credulous world, that a human life has been wantonly sacrificed to gratify a morbid passion for notoriety, not to attribute the result to a still less commendable motive.

The operating surgeon is not a mechanic, but the agent through whose instrumentality are carried into action the highest principles of scientific medicine, principles demanding an intimacy with the soundest physiology. He wields a power more grand, and more critical, and, at the same time, more terrible to humanity, than the member of any other branch of our profession. Compared to his authority and power, when engaged in his legitimate path, the pursuits of the physician appear both trivial and tedious. The occasional error of the physician is corrigible, that of the operator is fatal. Life and death hang suspended on his effort; health, recovery, deformity, and death are the issues of his hand.

There is no department of medical practice more attractive to the younger members of our profession than that of Operative Surgery. Its brilliancy, its eclat, its critical influence on disease, all contribute to this popularity, and attach an interest to it in the minds of the student of medicine far beyond that connected with the study of any other department. The value of a hospital is appreciated by the number of its operations, not by the exhibition of the curative power of its surgical staff, and still less by the success

which follows the frequent resort to the knife. The operating theatre is a place of weekly resort, the "high change" of the institution, at which we find united the largest assemblage of professors, of students, and their friends. Is not this enthusiasm somewhat misapplied? Between the claims to respect of Curative and Operative Surgery, there is no comparison. I venture to say, with all respect to my many superiors in surgical acquirement, that it is the duty of the teacher to expatiate with all the power of his authority on the superiority of the one over the other.

There is no greater obstacle to the advance of high classed surgery, than the man who, having acquired the reputation of a dextrous operator, regards the world as the great field of his experiments. A man who has the reputation of a "splendid operator" is ever a just object of suspicion; and I firmly believe that the bad operator, conscious of his weakness, will be found to have ever been the larger contributor to scientific surgical knowledge.

Two brief anecdotes will illustrate the principle. An eminent member of our profession is asserted to have said, "I have achieved my present rank by wading up to my knees in blood." Of another, and no less eminent man, it is said, that on being told by a medical friend that he had just witnessed a "beautiful operation," he looked at the observer with an eye of indignation, and replied, "Sir, I do not comprehend what a 'beautiful operation' means. I have never seen the operation to which the term beautiful could apply." Both these great men were at fault. At the period adverted to, doubtless, the value of human blood (although John Hunter had already established its vitality) was not appreciated, any more than were the remaining components of the body. The other authority must have acknowledged that perfection in any art is a source of the highest beauty. Both these sentiments are in extremes.

There is a position which Operative Surgery is entitled to

hold in our esteem, and which, so long as it does not clash with, nor interrupt the studious and persevering effort of the surgeon to render its aid unnecessary, must ever rank among the most valuable departments of scientific medicine.

How far I have succeeded in accomplishing the task I have undertaken, and in fixing on its proper basis this really important branch of medical knowledge, in warning the surgeon from paths of danger and of difficulty, and of testing the question of every operation, *in foro concientiæ*, before it is undertaken, I leave to the decision of others. I am old enough in my profession to have witnessed in past times much of wrong; I hope to live long enough to see this wrong converted into right. I have endeavored, as an English metropolitan surgeon, to carry into execution at least one primary object, viz., to strip the science of Operative Surgery of a false glare, mistaken by the ignorant for the brightness of real excellence, to check a spirit of reckless experiment, and to repress rather than encourage the resort to the knife as a remedial agent. I do not pretend to have executed my task perfectly, or even to have reached the level of my own view of the necessities of the case. It may be charged against me that I have expressed freely, and perhaps more authoritatively than I am entitled, my own individual opinions, and have made little reference to those of others. In answer to this charge, I have only to remark, that I do not profess to give the multitudinous opinions of other men, and yet I have not withheld them. I have quoted the opinions entertained by most of the eminent members of the surgical profession, so far as a general intercourse and an extensive acquaintance have enabled me to command it. The character of my mind is not attuned to authority, and it has been my practice, no less than my principle in life, to think for myself. A tolerably extensive intercourse with disease has led to the opinions which I have embodied in the following work: I profess no more.

I must in candor, however, make an exception in behalf of the operations connected with ophthalmic surgery, in which my opportunities have been comparatively limited, and in this department I have not hesitated to make an extended reference to the works and opinions of others.

I am anxious to make my acknowledgments to my friend, Mr. Savory, of St. Bartholomew's Hospital, who has lent me, throughout the work, his very valuable services, and of whose advice I have repeatedly availed myself. A season of probation is due to all members of our laborious profession; no amount of knowledge, no quantum of industry, no acquired accomplishment, can obtain a level path to fame, or give to youth the stamp and experience of age: Mr. Savory will bide his time; but I am greatly in error if he do not hereafter tread the highest paths of professional eminence.

CONTENTS.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VII.

CHAPTER VIII.

CHAPTER IX.

CHAPTER X.

CHAPTER XI.

CHAPTER XII.

CHAPTER XIII.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XVI.

OPERATIVE SURGERY.

CHAPTER I.

INDISPENSABILITY OF OPERATIVE SURGERY AS A BRANCH OF MEDICINE. —FREQUENT NECESSITY OF SUBMITTING THE QUESTION OF AN OPERATION TO THE JUDGMENT OF OTHERS.—REQUISITES FOR PRE-EMINENT RANK IN OPERATIVE SURGERY.—DUTY OF ASSISTANTS.—VARIETY OF INSTRUMENTS.—INDIVIDUAL RESPONSIBILITY OF THE OPERATOR.—DUTY TO PATIENTS.—CONDUCT IN THE CASES OF CHILDREN.—CHLOROFORM.—EXCEPTIONS TO ITS USE.—TREATMENT PREPARATORY TO OPERATIONS.—OPERATIONS OF EXPEDIENCY.—AFTER TREATMENT.

It has been often asserted, with some show of truth, that operative surgery is the opprobrium of medicine; but it is not really so. When an operation is resorted to for the purpose of removing from the body a part diseased, which the skill or the patience of another man would have cured by the hand of nature, then alone does an operation become opprobrious. So long as man is the subject of accidents, by which his limbs are lacerated, or otherwise violently disorganized—of tumors, whose increasing size and relations are injurious to the growth, or to the free actions of the trunk or limbs—of deformities, of stone in the bladder, or indeed of many other diseases, so long, probably, will the knife be resorted to, as our legitimate and only resource, against a greater evil—death itself. The knife should be essentially conservative in its operation; not to be employed as a shield to ignorance, or the stepping-stone to notoriety, but solely as the compulsory alternative to an evil of greater magnitude. In the profession of a surgeon the employment of the knife is the most striking, though not the most useful feature,

distinguishing it not only from the other professions, but from the other branches of his own.

A too common incentive to the performance even of a necessary operation, is derived from the eclat attendant on its successful termination. This eclat, this love of notoriety, inseparably interwoven with human character, has a tendency to distort the judgment, and to weaken the reliance of the operator on the curative powers of nature. Against these evils it behoves every upright man most carefully to guard himself; to watch with a just and jealous eye the welfare of the patient, whom circumstances have consigned to his charge, and to identify himself with his cause; to discard from his mind every thought or inclination, that may tend to divert his judgment from the one only consideration which should engage it, viz., *is this operation necessary?* or does it hold out the promise of benefit, which will more than counterbalance the evils of its performance? If the judgment of the surgeon waver in its decision on the question, a consultation with the highest accessible authority should be resorted to, with a view to bring the matter to an issue. Diseases for which large operations are required, and are performed, are for the most part serious in their nature; the presence of which may be supposed liable to become either fatal to life, or to the utility of a part on which health more indirectly depends. The removal of such a disease becomes, therefore, a question of "life or death," as it is called; and the restoration to health of a man holding an important rank, or in the performance of important functions in society, or the mother of a large family, whose future happiness, and often the very station of which, depend on her resources to carry out her own scheme of education for her children, is almost equivalent to a gift of a new life to the affected person. And even when a disease is more remotely injurious, as the cause of continued suffering from pain, or even from what we term irritation, although it may not be in its nature injurious to life, still the benefit conferred on a patient by a successful operation, is distinct in its nature, and larger in its effect, than the successful treatment by the physician of even an equally serious disease; inasmuch as the former, viz., that by surgical operation, is sudden in its effects, and critical in its agents, and is brought about by means more widely removed from the curative agents employed in every-day life. All this gives both eclat and emolument to the surgeon; and how many members of our profession may trace the success of their past career, to the

early performance of a good operation on an opulent and generous neighbor!

It will readily be granted, then, that the greater the service rendered, the greater will be the prospect of mutual benefit to the surgeon, and to the patient; and looking to the frightful alternative of failure, by which a person, who at the earnest recommendation of his surgeon has submitted to a large operation with a view to prevent a future and contingent evil, is laid upon his death-bed, the no infrequent issue of "operations of expediency," does it not behove the operator to call forth, either in his own person or in that of others, the exertion of the soundest reflection, and the most calm and disinterested judgment?

The requisite qualifications for an operating surgeon are partly moral, partly intellectual, and partly physical. Moral, indeed, in the most extensive application of the term, whether applied to the government of himself, or to his relations to the world.

A man is disqualified for these duties who cannot divest his mind of the sense of all personal advantage accruing to him from the performance of an operation—who cannot in imagination place himself in the position of his patient, and reflect on the case in all its bearings, and calculate the result as though his own personal health were directly involved. The moral relation of the surgeon to his patient also forms, in many examples, an important item in the calculation of the issue. The larger the share of confidence entertained by the patient in the skill and resources of the surgeon, the more fully will he be able to divest his mind of apprehension as to the result: he convinces himself that the operation has become a necessary evil, leaving no reasonable alternative to its performance, and he buckles on his armor for the effort. At such a time a man is an object of just and natural sympathy; and it is rare that sympathy does not tell beneficially upon his mind, provided its expression does not betray, on the part of the surgeon, a nervous disquietude, lest the extent of suffering be greater, and the issue more uncertain, than have been represented. A peculiar kindness, and in the example of a female or a child, even of tenderness of manner, begets a confidence, which, without betraying weakness or uncertainty, fortifies the patient's mind, and reconciles it to the effort.

A perfect knowledge of what he is about to undertake is among the most important requirements of the operating surgeon. The

nature and form of every operation should be thoroughly determined on, before it is commenced; and under the circumstances of any unusual form of operation, or of his own limited experience in such as may be common to others, every detail should be made the subject of his anxious deliberation and forethought. A large experience can alone supply the place of this practice. But no previous study or reflection can supersede the necessity of a perfect intimacy with the structure of the region about to be operated on. A surgeon may get through an operation here and there, who is ignorant of the anatomy of the part; but no man can aspire to the reputation of a successful operator, who is not familiar with the anatomy of the entire body, and who not only knows under what circumstances he may endanger life by the division of important structures, but who possesses that almost equally important knowledge, viz., where he may divide and dissect without danger. This negative knowledge is valuable, because, as it insures confidence in the informed surgeon, it enables him to proceed rapidly and boldly onwards in the execution of his task, avoiding an evil incidental to bad operators, viz., that of *picking* in pieces those structures, that should be freely and rapidly divided by the knife.

Dexterity of hand, natural or acquired, is indispensable to a perfect operator. By the term "dexterity of hand" is meant the power of entire command over its movements, which should be at the same time firm, but light and graceful, the sensibilities of which can best appreciate the nature, and the kind of force required on applying the edge of a knife to a surface to be divided. There is no doubt that this power may be greatly cultivated and improved by art; but it can only prevail in perfection, in men naturally gifted by its possession. This freedom and play of the hand is closely allied to that exhibited by some youths, who possess a remarkable facility of penmanship. Both the knife and the pen require the same freedom of movement, and are both similarly held. As a general rule, a good caligrapher possesses the manual requisites for a good operator. By far the best school for operative dexterity is the dissecting-room, in which the hand has, from early practice, acquired the power of implicit obedience to the will. It is, perhaps, only in a long experience of these duties, that the hand will be able to adapt itself with facility to all the varieties of movement which operative surgery demands, and which it instinctively adopts, in the course of a protracted operation. Dexterity of hand is the sum total of an exact and perfect command over the

agents of flexion and extension, of both hand and fingers, joined to a natural grace in its movements, which not even experience can furnish. To this dexterity, superadd long familiarity with the nature, density, and resistibility of the structures to be exposed, by which the force of the knife is regulated, and we have some of the physical requisites of a good operator.

Dissection alone can teach us, not simply the movements of the knife as effected by the hand, but the real use and value of the instrument. An unpractised operator is in difficulty, unless his knife be fashioned after a particular form, and retain its perfect edge. The experienced operator, if it may be so expressed, can *get more out of a knife.* It will continue longer obedient to his will; it will do more work, and is less damaged by *his* actions, than by those of another man.

To whatever degree of fineness the edge of a knife may be brought by the art of the cutler, it should only be employed to divide parts on the principle of the saw; which, in reality, tears minutely asunder any soft material upon which it is drawn. The nearer the action of the knife be made to correspond with that of the saw, acting however in one direction only, and the lighter the movement, and the less the pressure of the hand, provided the edge be applied, like a saw, parallel to the surface to be divided, the more perfect will be the wound, and when brought into contact, the more readily will it re-unite. A great art in the use of the knife consists in adapting the requisite force to the surface to be divided, and this is much better effected by a light, than by a hard pressure of the hand. The immediate agent of division is the knife, and not the hand. The hand regulates the force, and should employ as little as possible, not for the purpose of saving power, but because, as above stated, the cleanest, and consequently the healthiest, wound is effected with the least pressure.

To natural or acquired dexterity of hand, and an intimate knowledge of the structure of the body, should be added by the operator the yet further requisite of self-confidence; confidence in his own powers, and confidence in his possession of all the requisite knowledge, to carry out his end. He should possess great firmness of purpose, founded on the only solid basis of rectitude of intention; a command of resources against difficulty or danger, to be acquired only by previous thought and preparation, and a self-possession which no accident, however unlooked for, can disturb or alienate.

From the first moment of the operation, up to that of its completion, the lips of the operator should be closed to the discussion of all matters not requisite for its furtherance. The occasion is a grave one. He has one end only in view, viz., to complete his painful task, and place his patient at rest. He should not comment on his tools, nor give tongue to thoughts most inapposite to the occasion; such as opinions on the nature of the disease, or the anatomical names of the parts exposed. The occasion should not be employed for the purpose of a demonstration to pupils and juniors. His directions, if necessary, should be given to his assistants plainly, briefly, but intelligibly; and nothing more should be said than is absolutely requisite; for talking and acting antagonize each other, and the more latitude permitted to conversation, necessarily the greater the length of the operation. One authority alone should prevail. All necessary consultation should be held, and all necessary directions should be given, in the absence of the patient; and if in the room used for the purpose of the operation, before his admission to it. If the operation have been well conceived, and clearly sketched in the mind of the operator, there will be no excuse for deviating from these rules; but in all unusual operations, particularly in that of removal of large tumors, critically placed, and intimately connected with surrounding parts, which baffle previous calculation, and in which a perfect knowledge of the anatomical relations of the part can alone carry the operator through it with credit, here, a consultation with his colleagues or assistants may become necessary in the course of the operation:—unless the patient be placed under the influence of chloroform, and unconscious of what is passing, the chief parties should retire into an adjoining room, and confer with each other, the difficulties in the path of the operator be quickly and briefly stated, and the operation resumed as early as possible. These remarks will equally apply to hospital, as to private practice.

Previous to the operation, the instruments to be employed should be laid out on a small table; every description of instrument and appliance that may possibly be called into requisition, should be arranged on this table, the variety of which will give evidence of forethought. A list of the instruments to be employed, including every form that contingencies may require, should be written down, in order that the operator may have at hand every agent by which to prevent interruption in the course of the operation. The table should be placed within reach of the operator, that he may assist

himself to any instrument he requires, and which want no looker-on can determine so early as himself. Generally, it is better that the instruments be so placed as to be immediately accessible to his own hand, than that he depend on the aid of an assistant for an instrument, which it may require the delay of some seconds of thought to give a name to. Until the patient be placed on the operating table, these instruments should be covered with a towel.

A plausible objection may be raised to the employment of a great variety of instruments, and especially so when these instruments are complicated in their principle, or in their construction. Simplicity in the construction of surgical instruments, as in all other forms of apparatus, is a desideratum; but to attain the secondary object we should not sacrifice utility. No doubt men possessing peculiar dexterity of manipulation may accomplish as much by old and rudely fashioned tools, as others, by the aid of more refined improvements in art. We may have variety, however, without complication; simplicity of construction, with number.

For example, in the attempt to pass a ligature under the subclavian, or iliac arteries, it is impossible, before the artery be exposed, to select one form of needle that may not be justly superseded, during the operation, by another. The surgeon, therefore, should have several at hand, from which he will select that most suitable to his wants. I conceive, therefore, that the objections to variety of instruments are ill-founded, and unjust; and that a surgeon ought to possess every form of instrument that may facilitate his progress throughout a difficult operation. While I am prepared to acknowledge that the artificial assistance from instruments forms a bad substitute for what ought to be effected by the hand alone, and with most surgeons is effected by the hand, yet it cannot be denied that instruments which can represent the hand, and that can be efficiently employed beyond its range within the orifices of the body, should not be discarded as unworthy the resort and employment of the operating surgeon.

Almost every operation is better performed in the recumbent position of the body, whatever the locality of the disease, and especially if it be likely to become protracted; for, however bold and resolute the subject may be at its commencement, yet loss of blood and continued suffering beget languor, and a total loss of resolution during faintness, which is the more probable attendant on the sitting than the recumbent position: the patient is of course liable to slip down, and create confusion and difficulty.

Much of the comfort of an operator—a consideration of great moment—will depend on the selection of the operating table on which the patient is laid during the operation. It should be neither too narrow, by which a sense of insecurity will be felt by the patient, nor too broad, which compels a forced position on the part of the operator. A table too high or too low has obviously equal objections. Whatever form be selected, its strength and firmness should be ascertained before the patient be consigned to it. I have seen a table literally come in pieces in the middle of an operation, and the patient fall to the ground; and it should be made as comfortable as possible, by means of a blanket repeatedly doubled, and covered with a sheet, and the head may usually be supported on one or more pillows.

It is the duty of the operator to assign to each assistant his portion of the undertaking; to place each in the position in which his duties are most readily performed. That of the chief assistant consists in what may be termed, *multiplying the hands of the operator*, by the addition of his own; his duty is with the wound, the progress of which he should vigilantly observe, and endeavor to trace the current of thought passing in the mind of the operator, and to second his wants. In fact he should realize the idea of one mind acting by four hands, instead of two; so entirely should his actions harmonize with those of his principal. If the hands of a second assistant be required in, or about the wound, the two should have distinct, even if corresponding duties, assigned to them; but neither should exceed his duty by the interference of word or act.

If the assistant become cognizant of any untoward circumstance in the course of the operation, unseen by the operator, such as the occurrence of hemorrhage from a large vessel, or the incomplete division of a part supposed to be clearly divided, or the unsuspected proximity of a large artery, the fact should be communicated to the principal, by a look, or a single word. To another assistant will be assigned the less important duty of providing a succession of clean sponges, of which an ample supply of the best and softest kind should be furnished. It is a part of his duty to ascertain that a sufficient quantity of hot and cold water is at hand, or readily obtainable, with basins, slop-pails, &c. In serious or protracted operations, a fourth assistant may be profitably employed in personal attendance on the patient, whether for the purpose of holding his hands, or of administering such cordial or stimulating drinks, as may

be directed by the principal, regulating the temperature of the room, &c. The assistants, however, should be careful not to trespass unnecessarily on the area required for the respiration of the patient, by which his sufferings are considerably augmented, and the tendency to fainting promoted.

It is very desirable to select a good daylight for the performance of every operation; and, generally speaking, the earlier the hour selected in the middle of the day, the better. By this arrangement we avoid the natural exacerbation of evening. The objections to operations by candlelight are great and manifold: first, the exposed parts present a different aspect to the eye, from that which we have studied; secondly, artificial light, however brilliant, is both dazzling and imperfect, throwing a shadow on parts not immediately exposed to its rays; and thirdly, it occupies on minor matters the attention and charge of assistants, whose duty consists in acts of more direct co-operation with those of the principal surgeon.

If the hour selected be necessarily a late one in the day, the probable duration of the operation should be calculated; and, as such calculations when made are almost invariably wrong, at least double the calculated time should be allowed before sunset; this being the latest moment at which it should be commenced.

Although the necessities of the case ordinarily preclude our selecting the season of the year for the performance of an operation, yet it is well to observe, that all seasons are not equally eligible; and it would be well, if possible, to avoid selecting the summer season, during which unusual heat prevails, the influence of which on the nervous and circulating system of a patient cannot be otherwise than injurious. Perhaps the majority of cases, such as large tumors, stone, aneurism, &c., might be subjected to the postponement of a week or two, without disadvantage.

In all cases of operative surgery, in which the operation is considerable, and likely to be attended with loss of blood, or to occupy much time in its performance, every arrangement necessary for the disposal of the patient on its completion, should be previously made. The bedroom and bed should be prepared for his reception, and his own dress be suited to it. It would be difficult to imagine a wound which, however carefully brought in apposition, would not be more or less deranged by the simple exertion of changing a day, for a night-shirt. Hence the necessity for looking to every contingency, with a view to avoid the effects of violence. For example, it

is most desirable that an operation be performed in the bedroom which the patient is to occupy, or in a room contiguous to it. Among other important requisites, is that of a good nurse.

It should be fully understood, that the operator alone is responsible for the success or failure of an operation. He cannot plead the directions or advice of a physician, who may deem the operation requisite. The physician may transfer the case for the consideration of the surgeon, who may undertake it or not, as his opinion may lean favorably, or otherwise. Mr. Abernethy, in referring to this subject of medical ethics, used to mention, that he was one day sent for by a physician to tap a lady for ovarian dropsy; examination convinced him that the contents of the cavity were too albuminous to pass through the largest canula, and declined the operation, to the indignation of the physician. The lady shortly afterwards died, and a post-mortem examination proved the correctness of his diagnosis, and the futility of the proposed attempt to relieve her.

In taking charge of a case from the hands of another medical man, the operating surgeon takes with it all the responsibility that the case may entail; and he should obtain the entire concurrence of his own judgment, before he undertakes its charge. This principle requires the stricter observance in the transference of cases from the physician to the surgeon; first, because the question of operation may be of vital moment to the patient, arising from the fact that the practice of the physician is such, as involves the consideration of organs, the health of which is indispensable to life; and secondly, because, from the nature of his professional duties, a physician can afford us little aid, consequent on his inexperience in the difficulties of operative surgery; nor is it to be expected that he will volunteer unnecessary responsibility. The suggestion of an operation by another practitioner, whatever his rank or position, is no warrant for its performance; unless the conviction of its necessity be brought home to the mind of the surgeon, he may decline it. The exposure of the cavities of the body, especially, cannot be effected without danger to life.

Take, for example, a case in which a foreign body has lodged in the bronchial tube, the diagnostic signs of which are always more or less difficult, and in which a surgeon is called on to operate for its removal. The history of the case should be given him—the symptoms detailed—the grounds of the opinion, and all obtainable evi-

dence and indications, clearly exposed before his view. While it is the duty of the physician to endeavor to convince him of the indispensability of the operation, it is equally his duty to weigh the danger of the undertaking. Confidence in the rank and competency of the physician will go far towards influencing his mind as to the desirableness of the attempt proposed; but he should place in the opposite scale all the surgical difficulties that may be reasonably urged: he should weigh his own responsibility, and calculate his own powers. The authority of the physician, if based on acknowledged experience in his profession, and a superior intelligence, should be allowed its full weight on his mind; but it cannot supersede the necessity of his obedience to a conviction that his professional duty permits him no alternative but its performance.

Operative surgery not infrequently involves interesting questions of medical ethics. The duty of the surgeon should be clearly defined in those frequent examples of operations for disease, of which the ultimate result is doubtful. His opinion should be stated in the most unreserved and candid terms—the chances of recovery, both immediate and remote. However desirable it may be that the mind of the patient be animated by a full share of hope and confidence in the issue, this desideratum cannot justify his withholding the honest and unreserved declaration of his thoughts and opinions. Take the example of scirrhous disease of the breast, or elsewhere. The removal of such disease may be recommended in favorable cases, such as those in which the diseased parts are nearly or entirely insulated, or in which the neighboring glands are free from contamination.

It may be truly argued in favor of the operation—first, the uncertainty of the nature of the disease, should it admit of a doubt; (and no form of surgical knowledge is at the present day more imperfect, than that of the nature of tumors;) and, secondly, the possibility that being cancer, it may not return at some future day. Against any unreasonable objection on the part of the patient, the surgeon may direct the full force of his arguments; such as the fear so frequently expressed by patients, that they shall die on the table. This is a legitimate subject for persuasion; but under all circumstances in which a patient is compelled to rely on his, or her own judgment in the decision, whether an operation shall or shall not be undertaken, it is, I conceive, the duty of the surgeon, and no less his real interest, to throw off unnecessary responsibility by a truthful statement of his opinion, which shall

conceal nothing. We may contend against morbid or overcharged apprehension, or against weak anticipations of contingent evil; but we should not conceal nor withhold the evidence of the just probabilities of the future, nor contend, by argument or entreaty, against the deliberate decision of our patient, founded upon the candid declaration of our own opinions.

There is one mode of meeting this difficulty which may often be resorted to with success; it is that of rendering the patient's family or friends the medium of communication between the surgeon and the patient. There are manifest advantages obtained from this kind of relation between the principal parties. First, the surgeon can speak more freely and unreservedly to persons only secondarily concerned. Secondly, he obtains the exercise of the calmer and more disinterested judgment of one who is equally desirous of weighing every probability, and more competent to meet the occasional idiosyncrasies of a patient's mind, and who, in the exercise of the right of a parent, relative, or friend, may urge the expediency of the operation in more positive terms than could be justly employed by the surgeon. And, thirdly, should the operation be determined on, it enables him, in the commission of a pious fraud, to qualify the prospect of liability to a return, and to infuse confidence and hope into his patient's mind.

In the case of children, also, difficulties arise which involve moral considerations. Let us suppose the case of a child who has sustained an injury from machinery, and in whom it is, in our opinion, essential to its recovery that an operation be immediately performed, the parents living at a distance, and in ignorance of its state. In the absence of the natural guardians of the child, the surgeon becomes the representative of the parent, and he should act upon the best judgment he can arrive at.

This difficulty, not very great in the above relation of the parties concerned, becomes more urgent when the child has reached that period of life at which he begins to throw off the authority of his parent, and to assume his own. The date of this change has no fixed term, but depends both on the moral and on the intellectual development of the child. I have known examples of boys of thirteen, fourteen, or fifteen years of age, the subject of serious laceration, the consideration of which has involved the question of amputation of a limb. Imagine a boy so circumstanced, young, but precocious, deprived of the advice and authority of a parent, who

declares that he will not submit to an operation, but would prefer to die, rather than lose a leg. How should the surgeon act? Is he justified in doing that which his knowledge and experience tell him is right to be done? Supposing the earnest recommendation of himself and others to have failed in obtaining his patient's consent to the removal of the limb at this equivocal age, and compelled to act, I think he should represent the side of reason, assume the position and the functions of friend, or parent of the boy, and compel him to a course to which he would unhesitatingly subject his own child.

The sentiments of the parent, on his arrival after the operation, may correspond with those of the son, expressed before it. He may ask, with some appearance of reason, by what authority did the surgeon remove his child's leg against his own consent, or that of his parent? The answer is, that the operation was necessary to the preservation of the boy's life; that it did not admit of delay, and that, in the absence of the parent, the authority of the boy was insufficient to outweigh the decision of reason and experience; thus presuming that the restoration to its parents of the mutilated person of the child is preferable to the almost certainty of his death, should the surgeon yield to his wishes. This decision, however, would be greatly modified, supposing the injury sustained, to be less unequivocal. The doubt of the necessity for an operation should be thrown into the scale of the boy's unwillingness to undergo it; and it should be foregone, or at least postponed, till the parent's sentiments be ascertained.

A difficulty occasionally arises between two or more medical men, which also involves a question in medical ethics, or rather of etiquette, viz., by whom shall the operation be performed? Should the patient select an individual, the question is readily settled; but patients rarely interfere between the parties, taking for granted the matter-of-course arrangements of the profession, determined on between them, at the necessary consultations that ensue. If this consultation take place between two surgeons, one of whom only is notoriously in the habit of operating, the case would be transferred to him by his colleague, and on the operating surgeon would rest the responsibility of the case, and the entire of its after treatment, which should always be considered a part of the operation. If the operation be one of lesser moment, and his colleague in the case propose himself to undertake it, and to which, under all circumstances, he has the first claim, provided he has the concurrence of his patient,

his intention should be clearly expressed at the first interview between them. Between two or more surgeons engaged, priority would determine the person of the operator. On the operator, or his representative, should always devolve the after treatment, unless by express arrangement to the contrary, who should become responsible for the principle of his treatment being carried out, whether effected by his own hand, or by that of another person under his advice and direction.

One of the most interesting questions connected with the subject of operative surgery relates to the use of anæsthetic agents employed for the purpose of suspending the function of sensation. This question has assumed a moral, as well as a medical type. It has been urged, that sensation is a natural function of the living organism, and that to suspend it by artificial agency is to set at naught the ordinances of nature; and that man is born to suffering, as evidenced by the sensibilities of his body. If the soundness of this argument be admitted, it would be difficult to draw a line which would define the boundary at which moral and *immoral* suffering meet; or to say, in what form of suffering our remedial agents may be justifiably resorted to. The sensibilities of our frame are not given us by nature to the end of promoting pain, but to enable us to avoid it. Corporeal suffering is no part of the discipline of the mind; nor can it even be generally asserted, that its excess exercises a salutary influence on the character. Every movement of our body instinctively points to the avoidance of bodily suffering; why, therefore, should we not as readily and unobjectionably employ the agency of anæsthetic medicines for the purpose of suspending bodily pain, under the circumstances of an otherwise painful operation, as we endeavor to mitigate the bodily suffering of any other patient, cast down on a bed of sickness? Will not the objection to the anæsthetic action of opium to a region affected by a neuralgic pain, or to the system generally, hold as strongly as that of another agent of the same principle, given to avert the pain of an operation?

The medical arguments against the use of anæsthetic agents have a somewhat better foundation. That great and sudden determination to the brain, and an unnatural circulation of venous blood, result from their employment, is undeniable.

It is undeniable, if the quantity administered be large, and

long continued, that symptoms resembling those of apoplexy present themselves, in the form of extreme congestion of the vessels of the face, stertorous respiration, and total insensibility; and it cannot be denied that occasionally, its full administration leads to headache, vertigo, and languor of some days' duration; and cases are recorded in which even death itself has followed in the course of an hour or more after its employment. It must be observed, however, in pursuing this question in strict accordance with the laws of evidence, that we have no *proof*, in the cases above referred to, that death was the direct effect of the supposed cause. The parties administering it were not fully experienced in the mode of its application. They entertain the *opinion*, that death was referable to it, while it cannot be disputed that the fatal issue may have been attributable to other causes; and, in one example, it appears more reasonable to refer the death of the individual to a suspension of the function of respiration by violence, than to any obnoxious agent circulating through the lungs, or brain. On the other hand, the records of St. Bartholomew's Hospital point to its successful administration in upwards of nine thousand cases; in not one of which, including the aged and the young, the healthy, the infirm, and the asthmatic, has its employment left a stain on its character, as an innocuous agent of good. Under all circumstances, its careful employment may be unhesitatingly resorted to in all cases, excepting only such as are marked by determination to the brain of an apoplectic type; secondly, under circumstances of great and serious exhaustion from loss of blood; and thirdly, in diseases of the heart. In these conditions of the system, it is perhaps better avoided.

The agent in general use is chloroform, and one word may be added as to its administration. It appears indisputable that its influence on sensation precedes that on consciousness. I have employed it on several occasions, in which a patient has been conscious of all that has been passing around, and yet who has declared himself to have been totally insensible to pain. The state of his system has arisen from the moderate use of the agent, ample, indeed, for all purposes of utility, though somewhat difficult to regulate in quantity sufficient for the required object.

I prefer its gradual administration. I do not think it desirable to exclude atmospheric air, employed as a diluent during the process of inhalation. Its influence should be gradual, not sudden. I consider its application through the medium of a cambric handkerchief

laid on the face, preferable to the use of instruments made for the purpose of excluding atmospheric air, and food should be rigidly avoided before its administration, otherwise sickness will frequently follow.

Against the occasional convictions or objections of others to its employment, I place the strong, and to my own mind, the unanswerable fact, that it has been successfully used in so large a number of cases in St. Bartholomew's Hospital since the period of its introduction; that these cases have been indiscriminately taken, and that its objections have not yet made their appearance before the observant eyes of the medical staff of that institution, either by promoting danger during the operation, or protracting the recovery of the patient after it. In one class of case its employment is especially applicable; viz., in that form of disease in which the pain of an operation is the chief warrant for its non-performance, and in which the recovery from a chronic disease is left to nature, that might be greatly hastened by the hand of art; such, for example, as the removal of a piece of dead bone.

Up to the period of the introduction of chloroform, a surgeon was very unwilling to subject a patient to the painful process of sawing and chipping away portions of dead bone, with a view to reach the medullary cavity, because the operation was both a painful and a protracted one. The consequence was, that a hospital bed was occupied by a patient thus affected, for many months, to the exclusion, perhaps, of three or more claimants, who would have successively occupied it. By the aid of chloroform the operation is now performed unconsciously to the patient, and the period of his recovery greatly abridged. With the three exceptions above mentioned, I cannot hesitate in strongly recommending its administration in all cases of large surgical operations, believing its discovery to be the greatest blessing conferred on the profession of surgery during the last century; and although I have seen its employment pushed, on many occasions, to the apparent verge of apoplexy, I cannot say, even in such examples, that the good has not largely predominated.

One of the most important questions connected with operative surgery, relates to the treatment of the patient preparatory to the operation. It was formerly the practice to subject him to the medical discipline of purgation and deprivation of food, with a view to prevent the occurrence of inflammation. But since the commencement of the present century, more enlightened principles of the economy

have prevailed, and the old system is deservedly exploded; but something still remains to be done. The purgative system yet injuriously thrives, as the mistaken antidote to inflammatory action, and other consequences of violence to living structure.

There are two states of the health obnoxious to operations—viz., plethora and debility; but of all forms of debility, that which is most fatal to recovery is the *debility of excess.* It is of infinite moment, in determining the appropriate treatment, if any, to distinguish clearly the temporary excitement resulting from a stimulating diet, from the real force of tonic health. In the first, the health is apparent and not real; it is temporary, not constant; not an essential character inherent in the system; it is obtained by artificial and unnatural agency, and is exhausting in its influence on the vital powers. Every operation, however skilfully performed, is a shock to the system—against the effects of which, no treatment is so effectual as the negative reliance on the natural powers of a man's own unimpaired constitution. The agents of reparation must be necessarily more active in the tonic circulation of steady health than under that of occasional excitement, and consequent prostration. As a general rule, we have more to fear from debility than from excess, for we have the inflammation of debility, as well as the inflammation of excess, to contend against; and of the two forms, I believe the inflammation of debility, especially in large towns, is by far the more frequent consequence of local injury, or violence. The influence of operations on the nervous system, and more especially of "operations of expediency," as they are termed, is generally more severely felt than on the circulating system, for they are both more insidious and more intractable; and when we recollect that the repeated abstraction of blood, or a large purgation, cannot be resorted to without impairing, in a greater or less degree, the force of this system, it is obvious, that such depletive agents should only be resorted to on occasions of necessity, and always adopted with discretion; ever keeping in view the acknowledged principle, that tonic health is the surest safeguard against subsequent mischief of all kinds, and the best and safest guarantee for early recovery. All purgatives that produce liquid evacuations are, at such times, injurious. Whatever, therefore, tends to impair the constitutional powers tends to injury. The after stages of an operation, particularly those which have been attended with much loss of blood, call for the exercise of all the reparative powers that can be brought into

action. To reduce a patient by successive bleedings, or otherwise, is to throw a real danger on the latter stages, on the erroneous principle of averting an early one. But, however true these principles, we still meet with cases in which the abstraction of blood, in moderate quantities, is a useful and safe precaution, if not resorted to later than a day or two before the operation; and in many others it behoves us to regulate and restrict the diet—limiting the food to a quantity considerably within that usually taken. These remarks apply to middle-aged men in vigorous health, and of florid aspect, whose active pursuits in the country create and justify a large appetite for animal food. In such examples, the abstraction of eight or ten ounces of blood, restricted diet, and moderate purgation may be occasionally resorted to with advantage. A dose of laxative medicine for the purpose of simply clearing the intestinal canal may be reasonably administered, prior to most operations, if only for the purpose of preventing the necessity of any early movement of the person afterwards. All violent changes, whether of air or diet, should be avoided. Patients should become accustomed to a new locality before the operation is performed. I have frequently witnessed the injurious effects of operations on patients brought from the country, without this precaution being observed. The shock has proved excessive, and the recovery doubtful, or at least protracted. It is better that he reside for some days, or longer, in the new locality, to become habituated to the change of air, scene, and diet. This, and many of the preceding remarks, are intended chiefly to apply to the larger operations only, such as lithotomy, large tumors, &c.

By the term "operations of expediency," is understood that class of operations which are undertaken for the purpose of curing deformity, by the removal, or division of sound parts or of painless diseases, the evil of which does not exceed the level of inconvenience. The principle on which the frequency of the serious, and even fatal consequences of such operations is explained, is that of a shock to the constitution, totally unprepared for it. The nervous system is unconscious of the presence of disease, and suffers in proportion from the suddenness of the shock. The nervous system must take cognizance of its presence; the patient should have suffered something more than mere inconvenience, in order to its removal with impunity. It behoves us, therefore, on undertaking such operations, to be armed against their probable consequences, and to

watch with unusual vigilance for the evidence of their first appearance. These symptoms are confined, for the most part, to the affections of the nervous system, and are often very intractable. I have known death result from the removal of a toe, under the able management of Baron Dupuytren; and on another occasion, the same result attended the removal by the knife of an enlarged bursa below the patella. For much the same reasons, an incision into a large joint is often fatal to the articulation, causing inflammation, suppuration, and absorption of the cartilage, while we cut into a diseased joint with impunity; and probably there would be much more danger from an incision into a healthy bladder than into the same organ containing a stone.

The knowledge of the symptoms which indicate early derangement of the nervous system, consequent on local injury, whether occasioned by the agency of the surgeon, or occurring as the result of accidental violence, marks the excellence of the practitioner. Its study is one of the most difficult problems in the practice of the operating surgeon, consequent on the occult and apparently mysterious nature of these signs, which peer out in the form of slight unsteadiness of the pulse, irregularity in the respiration, occasional wandering of the thoughts, and other indications of disturbance, to be detected only on the closest observation and inquiry. These symptoms would pass unheeded by the unobservant practitioner till they reach a height at which they become too palpable to escape ordinary notice, while a vigilant observer detects their earliest manifestations. The value of this knowledge may be inferred from the fact, that the treatment which might be advantageously resorted to in inflammatory affections, and for which the above symptoms are liable to be mistaken, would tend to an increase of the evil, and to shake still more injuriously the stability of the nervous system.

The after treatment of operations should be dictated by common sense. For the same reason that operations which were formerly of frequent occurrence, are at the present day rarely resorted to, by reason of our improved knowledge of the powers of the economy; so the old and complicated practice of after treatment has given place to the employment of more simple, and at the same time more efficient agents. We rely on nature rather than on art. It is a part of this improved principle to eschew large and heating poultices and cataplasms; to promote comfort, rather than warmth; to *consult ease;* to forego the mistaken agency of medicine; to arrest hemorrhage

by the careful application of appropriate means, and to tranquillize the nervous system; in short, to follow nature, and not to attempt to lead her. Extra vigilance will be required in cases in which a large quantity of blood has been lost, because it is in such examples that we look for sinking, and the effects of prostration. Generally speaking, the earlier we can supply the lost blood to the circulation the better; and this can only be effected by the administration of nutritious food, which, for a time, the patient is indisposed to take; but when present, the inclination should be indulged to the extent of appetite, and hailed with pleasure, as the happiest testimony to the rallying powers of the constitution. I cannot, while on this subject, withhold my protest against the employment of simple decoctions of meat, beef-tea, for example, as agents of nutrition, with which patients, panting for nourishment after loss of blood, are indulged. If a basin of beef-tea or ordinary thin gravy soup be given to a hungry boy, it will be found that his appetite for solid animal food is entirely unshaken; he will subsequently consume his usual quantity of meat. I do not dispute the authority of Liebig and other chemists; I only state the results of my observation. If a patient express a natural desire for food, nature may safely become our guide, and his appetite should be indulged in moderation. The merit of beef-tea is rather that of a vehicle for more nutritious food, in the form of bread, macaroni, or rice: one or more eggs, beaten up in milk, or isinglass, to which two or three teaspoonfuls of brandy may be added, on the second or third day. Such food allays appetite, affords nutrition, and tends to the regeneration of the lost blood.

Thirst is an earlier indication of the want of nourishment to the circulation, after loss of blood, than hunger. After depletion of every kind, the desire for liquids precedes that for solid food, probably because it is more readily and more quickly absorbed into the circulation. To withhold drink from a person suffering painful thirst from depletion, is to interpose the erroneous principles of art in the path of a distinct and natural indication, and can only be attributed to gross ignorance of the functions of the economy. The drinks employed at such seasons should be rendered slightly nutritious, such as whey, or milk and water; and as soon as all danger is past, namely, about the third or fourth day, I have often known a glass of table-beer, or even draught-porter, if the patient has expressed a desire for it, effect a substantial and permanent good.

Neither should the bowels be teased with aperient medicine. *Constipation is the certain consequence of loss of blood.* It is by no means desirable that a patient have a daily action of the bowels, after considerable depletion. This also is a law of nature, palpable, and never failing. Nothing can surely be more readily understood than the principle that nature suspends the excretions, with a view to supply, by every absorbing means in her power, the blood that has been removed. This principle, so natural and so admirable to its ends, is not infrequently thwarted by the arrival of a dose of calomel, and a "black draught" for the following morning, which, to prevent all mistake, should be immediately consigned to the depths of that recess to which its action would have driven the unfortunate patient.

It is difficult to know what form of medicine to administer, that will not do harm; an occasional sedative being all that is required, and that not invariably. Purgatives, diaphoretics, tonics, anti-spasmodics, diuretics, one and all, are equally uncalled for, and equally prejudicial.

CHAPTER II.

ON THE DIFFERENT MODES OF HOLDING A KNIFE.—EXPERIENCE AND INEXPERIENCE IN ITS USE.—LENGTH OF INCISIONS.—FORCEPS.—SKETCH OF THE STRUCTURES BENEATH DRAWN ON THE SKIN.—SILVER KNIVES.—SPONGES.—PROTRACTED OPERATIONS.—HEMORRHAGE.—TIME OCCUPIED IN OPERATIONS.—CESSATION OF BLEEDING INDISPENSABLE TO UNION BY THE FIRST INTENTION.—EXPOSURE OF WOUNDS TO THE AIR.—NECESSITY FOR PREVENTING THE FORMATION OF A CAVITY IN A WOUND.—EXTERNAL PRESSURE.—ADHESIVE PLASTER.—SUTURES.—QUILLED SUTURE.—UNINTERRUPTED SUTURE.—INTERRUPTED OR COMMON SUTURE.—GLOVER'S SUTURE.—NECESSITY FOR PECULIAR CARE IN THE MANAGEMENT OF WOUNDS ON THE FACE.—UNION BY THE FIRST INTENTION.—UNION BY PRIMARY ADHESION.—FIRST DRESSING AFTER OPERATIONS.—EVIDENCE OF NON-UNION.—POULTICES.—ABSCESS.—IMPORTANCE OF SELECTING THE EXACT PERIOD OF MATURITY FOR PUNCTURE.—LIGATURES ON ARTERIES.—TETANUS.

THE knife being the instrument of most general use in the performance of all surgical operations, it is necessary to say a few words on the manner of wielding it to the best advantage, and of adapting its edge most aptly to the kind of surface to be divided by it. Its offices are required to divide parts in many different ways;—in cutting, paring, puncturing, dissecting, &c.; it is employed with firm or with light pressure, dividing masses of cutaneous and adipose structure, fascia, &c., or separating hard textures. To effect these various objects with elegance and dexterity, certain modifications of its position are required, as appropriate to each. The practice of these modifications, or varieties of position, is almost indispensable to the progress of the operation; and although they are in some measure adopted instinctively by the dextrous manipulator, to whom they appear natural, yet it may be desirable to lay down general rules for their selection, for the benefit of those who have either little experience in the use of the knife, or are not gifted

with a natural dexterity of hand. To dwell at any length on this subject is, however, unprofitable.

Fig. 1.

The *first*, and most general *position*, is nearly identical with that of a pencil, or pen when held in the act of writing, in which the instrument is placed obliquely forwards, between the fingers, having the thumb applied on the one surface of the handle, the index finger on the back, and the middle placed somewhat behind, or occasionally at the side, for the purpose of regulating the force employed by the index. The little finger, resting on the body of the patient, supports the hand. The index and middle finger antagonize each other's action. In this position we employ the knife for the purpose of any cutaneous incision, requiring the exercise of caution in the degree of pressure. The remark would apply in all operations for hernia, tumors near the surface of the skin, aneurism of nearly every region, Taliacotian operations, and many others. The dissimilarity between this mode of holding the knife and that of a pen consists in the position of the middle finger, which in the latter rather combines with the thumb and forefinger in holding the instrument firmly, the pressure of the three fingers being equidistant from each other; whereas, when applied to the knife in this, the first position, it gives support to the blade, and regulates the degree of force employed by the index finger, which is the sole agent of pressure. In order to render this position of the knife as efficient as possible, and to be enabled to draw it parallel to the surface, the fingers should grasp the instrument at the extremity of the handle, including a portion of the blade. But this relation of the hand will be modified by the length of the blade, which should be curved upwards considerably, rendering the last inch, if the blade be of the usual length, the really useful and the only employed part of

the knife, nearly parallel to the skin. The blade should be short, and the knife altogether strongly and firmly made. In making the incision, if a long one, the hand and little finger should be supported on the skin, and the remaining fingers extended nearly to their full length, in order to prevent the unnecessary movement of the entire hand. By the flexion of the finger and thumb, the incision is effected, which, if of insufficient length, must be extended by the sliding movement of the entire hand backwards. The flat surface of the blade of the knife should be held at right angles to the surface to be divided, otherwise the wound will be carried down in an oblique, and not in a vertical direction, a frequent fault in young operators.

A modification of this position consists in turning the blade backwards and the handle forwards, for the purpose of dividing from behind. The hand is then supported by the little finger extended,

Fig. 2.

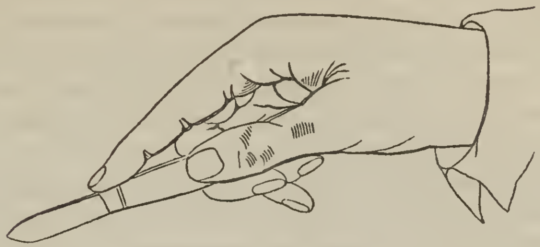
Fig. 3.

the instrument still grasped by the thumb and two first fingers. The thumb, partly flexed, now becomes the agent of pressure, antagonized by the index. It is a modification of the first position, not frequently resorted to.

The *second position* is nearly identical with that of a table-knife. The handle of the instrument rests in the hollow of the hand, and the index finger is placed at length on the back of the blade. The handle is grasped in the middle by the thumb and middle finger, which form the axis of its motion. The force may be applied in

two ways, first, by the pressure of the index directly on the blade, and, secondly, by the elevation of the handle into the palm, by the

Fig. 4.



ring and little finger, by which force the point of the blade is still further depressed. Usually, however, the ring and little finger are employed simply to fix the instrument more firmly in the hand. This position would be resorted to for incisions made to expose deep tumors, or is required in dividing through hard structures, such as the integuments on the back, or for any deep division of parts, of which the nature of the subjacent structure is fully known to be free from danger. Additional facility of division is given to this position of the knife by its parallelism to the surface. The knife is occasionally held like the bow of a violin, in which the thumb antagonizes all the fingers. This is employed in incisions transverse to the person of the operator; and it is also grasped by the entire hand, as in holding an amputating knife. Any further modification of the different modes of holding a knife may be safely left to the instinctive resources of the operator.

With regard to the mode of division of parts, care should be taken, as above stated, that the wound be made vertical to the skin; and this will be effected by the hand being turned inwards while in the act of dividing. The objections to the neglect of this important rule are, first, that supposing the incision be made on the face, for example, the after union of the edges of the wound will not perfectly correspond, in consequence of the inequality of the angle which each edge forms with the adjacent skin, and a broader cicatrix than necessary will leave its permanent mark, probably for life. Secondly, that as the first incision may be supposed to have been accurately made, as regards the part to be exposed, which may be a deep-seated artery, the consequence will be, that the direction of the wound will carry the operator by the side of, and beyond the vessel, without

exposing it; and this evil arises from the simple cause above mentioned, of dissecting downwards obliquely, instead of vertically. The process of exposing deep-seated parts, whether for their insulation and removal, or for the purpose of clearing away the cellular and fatty structures around an artery in a case of aneurism, is justly termed a dissection of these parts. The manner in which this object is attained bespeaks at once the experienced manipulator, whether possessing the experience of the dissecting-room, or solely that of the operating theatre.

The practised operator, familiar with the use of his knife, and confident in himself, divides boldly and freely: he makes his progress clearer at every incision; he prosecutes his work systematically, finishing whatever he begins, unless he has a good reason for the contrary; he operates slowly and steadily, but efficiently; every cut tells, every movement of his knife has a meaning and an object.

On the other hand, timidity marks the ignorant man at every step. Uncertainty and indecision characterize his movements; he passes from one part of the wound to another, without any rational object or intention; dissecting a little here, and dividing a little there—completing nothing. Finding his own resources fail, he lends an ear to the suggestion of one assistant, then to that of another; and adopting imperfectly the advice of each, he protracts the operation to three or four times the period required for its performance by a man of ordinary dexterity and knowledge, till, worn out with prolonged suffering, his exhausted patient is at length consigned to his bed.

The precise line over which the first incision should be made being determined, the next consideration relates to the length of the incision. The reasons against a division of unnecessary length are obvious, while those urged against the opposite error are, perhaps, still more striking. It is a very important object, in the accomplishment of a good operation, for the surgeon to clear his way as he proceeds, and to obtain space sufficient both to view and to handle freely the part either to be exposed, or to be removed.

It is a common fault of the unpractised operator to dissect the wound into the form of a cone, with its base directed upwards. This arises from his neglect in continuing the division of the structures within, to a length equal, or nearly equal, to the outer wound. Thus every successive stage contracts it in length, till he finally reaches a

point from which he is compelled to retrace his steps, with a view to make a more perfect division at each extremity of the wound, up to the surface of the skin, consequent on the contracted space into which his dissection has unhappily led him. Care should be taken to avoid this error from the outset. In difficult and complicated operations for the removal of tumors in the neighborhood of large vessels, such as the axilla, or the front surface of the thigh, the observance of this rule is of the utmost moment. The process should be one of *dissection*, in which the knife of the operator should be employed in clearing his way as he proceeds, by removing every obstacle from his path, completing each part of the work he has undertaken, before he advances to another. Let us suppose a large tumor to occupy the upper and inner region of the thigh, the nature, extent, and relations of which cannot be sufficiently ascertained to enable the surgeon to determine on his exact course of action. The external incision should exceed the length of the tumor by at least an inch or more in each direction. The fascia, when exposed, should be divided to the full extent of the outer wound. The disease is now found to be connected deeply, and covered not only by the sartorius muscle, but by the yet deeper adductors. The question then arises in the mind of the operator, how far it is necessary to divide the first of these muscles. This question would be solved by bending the leg, and drawing it inwards. If the muscle be now entirely relaxed, and be separated from its attachments, so as to enable the assistant to draw it aside with a blunt hook, it may be left untouched; otherwise it should be cut across, and its extremities at once dissected backwards, and turned off the tumor. This may become a necessary step in the progress of the operation, and is given as an example of that rule that requires all obstructions in the path of the operator to be removed as they appear. The same remarks will equally apply to the deeper muscles. It is almost unnecessary to add that all structures exposed, that do not interfere with the progress of the operation, should be left untouched.

If the outer wound be found of insufficient length—if its extent be such as to hamper the operator by requiring its extremities, or indeed any part of the wound, to be undermined, the effect of which will be, that one part only of the cavity can be brought into full view at one time; if it appear that the integuments must be drawn towards the part of the wound in which the operator is engaged, in order fully to expose the cavity, then it is obvious that the external

opening is inconveniently small, and should be enlarged, either in the longitudinal direction or by a cross incision, whichever may be found to free the surface of the diseased part the more effectually. There is no discredit in this after-division of the skin, and its adoption at any stage of the operation is preferable to persistence in the difficulty and danger of prolonged dissection in parts not fairly exposed to the eye. Should increasing difficulties arise, such incisions may be resorted to in any direction, and at any stage of an operation; for it is less offensive to the true principles of operative surgery that second external incisions be made than that the first should be disproportionately long to the size of the tumor.

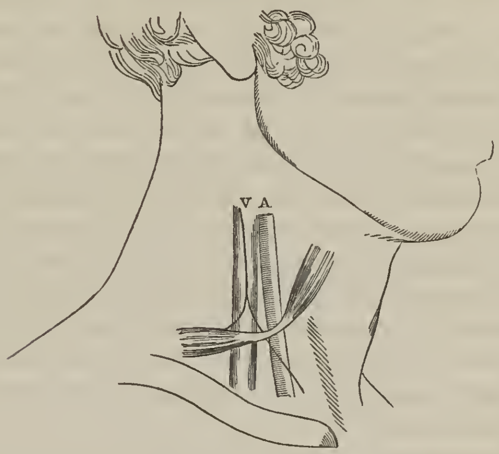
The operation should be advanced by every movement of the knife. The student of operative surgery should cultivate the practice of making a free division of the obstructing parts, such as the subjacent cellular tissue, fascia, and fat, &c. All that the knife can do with safety should be effected by each single movement of the hand, whether in the first incision or in the after-dissection. In the operation for tying the femoral artery, the first incision may extend downwards to the fascia. In lithotomy, the first incision may expose the groove in the staff, (*see* Lithotomy,) and the requisite depth of the remaining part of the wound may be almost perfected: even in hernia, the skin and external fascia may be divided by the first sweep of the knife.

The left hand, represented by the forceps, will determine the extent of each separate division by the knife, as soon as the operation is fairly commenced by the incision through the skin and subjacent fat. This instrument should possess requisite strength in the blade, and be well, but for this purpose not too acutely, pointed. The force of its spring should be such as will enable it to support its own weight between the finger and thumb at its fullest state of dilatation, without falling to the ground. If too weak, it can only be retained, when held vertically between the finger and thumb, by a degree of pressure which partly closes the blades. If the force employed in compressing them be too great, by reason of the unnecessary strength of the instrument, the hand will become fatigued by the continued pressure required to retain any small object in its grasp. Both these evils should be avoided. Whatever tissue be raised by the forceps should be drawn somewhat upwards, and when thus rendered tense, should be rapidly divided by the knife, and the forceps quickly reapplied to a new surface.

It has, for many years, been my practice, in the performance of large operations involving complicated structures, to sketch out a map of the parts implicated, with a pen and ink upon the skin, each line corresponding, as nearly as I could calculate, with the parts beneath.

I have here given a sketch of the neck with the carotid artery and

Fig. 5.



omo-hyoideus muscle. This practice gives confidence to the operator, by impressing on his mind, to the last moment prior to the commencing his task, the nature and relations of all the parts likely to be exposed. It is of great value in every form of Taliacotian operation; and, indeed, forms a very important element in their successful issue. The lines of incision may be profitably made even in excision of the mammary gland. In the cases in which the exposure of deep arteries is required, it insures, also, a correct start in the operation, by which the after stages are much simplified.

It is not always desirable that the edge of the knife be perfectly keen. The fact that a wound formed by laceration pours out less blood than another caused by incision with a sharp knife has been long known to our profession; and there is no reason why this principle in the economy should not be turned to advantage by the operating surgeon. Whether for the exposure of large arteries or the removal of large tumors, or in hernia, the escape of blood is one of the chief obstacles to the progress of the operation; and when the quantity is large, it ceases to be a mere inconvenience, and

becomes a serious evil. Much bleeding from small vessels may be avoided by the use of a blunt knife, which lacerates coarsely instead of minutely. I was indebted to Sir Benjamin Brodie, in the early part of my own career as an operative surgeon, for this useful hint; and I have seen the benefit derived from the employment of a knife with a silver blade too frequently to hesitate in recommending it as a valuable appendage to the operating case.

It pleased the late Mr. Liston to sneer at this suggestion, but in my opinion no prudent surgeon, who is not indifferent to the prevention of loss of blood, will undertake the kind of operation alluded to without being armed with a case of two or more instruments of this kind. The difference in the effects of a blunt and a sharp-edged knife is remarkable. From the moment of the application of the former, blood ceases to flow, the wound continues dry, and the operation proceeds without interruption. It is very true that its progress is comparatively slow; but for this evil, the clean and dry state of the wound, and the largely increased absence of danger from the division of any considerable artery, more than compensate. Arteries possess a singular power of averting the liability to division, by a knife employed with a degree of force that will divide many other structures.

A single remark on the use and application of the sponge may not be deemed irrelevant to the objects of a work on operative surgery, and which I am the more disposed to make, because I have too frequently witnessed the misapplication of this necessary and most useful appendage to the operating table. The sponge should be soft, for two reasons; first, because its application is required upon an exposed and sensitive surface of the body; and, secondly, because without being easily compressed by the hand, it cannot effect its object as an absorbent of the blood. The size of the pieces selected will depend on that of the wound, and, of course, on the quantity of blood to be absorbed by each application of the sponge to the surface. If the hemorrhage be considerable, five or six pieces will be required, and they should be frequently changed, and freely washed in clean tepid water; otherwise they are liable to become sodden, by the absorption of blood that coagulates in their interstices. The eye of the chief assistant, whose duty consists in managing the wound and in keeping it clean, should never be taken off it for a moment. The sponge should be applied to the bleeding surface quickly, pressed with some force upon it, and as quickly

removed, in order that the operator may resume his work on a comparatively dry and clean surface. One additional hint I would venture to give, viz., that the office of a sponge is totally distinct from that of a towel, or even of a brush, and should not be employed to wipe or rub the structures exposed, unless for the purpose of removing coagulated blood, but should be simply pressed upon them, retained for an instant, and withdrawn.

Additional to the shock on the nervous system, caused in a greater or less degree by all operations, there exist two collateral evils, on the occurrence of which the after progress of the case may give considerable trouble and anxiety. The first consists in the danger resulting from the time occupied in its performance, which may exceed the powers of endurance of the subject of the operation; and the second arises from loss of blood. In the first case, it should be recollected that many or at least some operations necessarily occupy a considerable time for their completion; that it is far better to prolong the present suffering of a patient than to leave our task incomplete, or to employ a dangerous force for the removal of a growth that should be dissected carefully from its connections. At the same time, it cannot be denied that the protracted length of an operation may be occasionally attributable to the want of knowledge or dexterity of the operator, and for which I can suggest no other remedy than that of placing the knife in other hands; a proposition that requires more than an ordinary share of moral courage, and that few men would willingly adopt.

The consequences of excessive hemorrhage should be carefully guarded against. The degree of attention bestowed on this probable cause of future evil will much depend on the sex, age, and constitution of the subject. If the subject of the operation be a delicate woman, or even a man reduced by long suffering or depletion, and still more emphatically may I urge, if a child, *no precaution tending to the prevention of loss of blood should be neglected.* The best means of contending against hemorrhage is that of completing the operation as quickly as possible. At the same time, I may observe, in extenuation of slow operators, that the loss of blood is not in a ratio with the length of time employed.

The quantity of blood lost in a quickly executed operation is greater, if compared with the time occupied by it, than in a prolonged one. For vessels do not continue to bleed with the force that attends their first division, arising partly from the diminished power of the

heart, and partly from their gradual contraction; and vessels of considerable calibre, that pour their blood freely into and around the wound, and the jet of which may reach the bystanders at a distance of some four or five feet, quickly lose their force of pulsation, and finally often become so reduced in size and importance as even to prove unworthy the application of a ligature.

The necessary consideration due both to speed and safety, (which are not infrequently synonymous terms,) may occasionally require the operation to be arrested, for the purpose of tying a wounded vessel, the bleeding from which interrupts its progress. We have an example of this in the superficial epigastric artery, often divided in the first incision in femoral hernia; but it should not be resorted to unnecessarily, and especially so when the subject is a strong and healthy man, and the operation is of a nature to promise early completion. The lesser subject of position should also weigh in determining the relative importance of loss of time and loss of blood. If the position of the patient be an irksome one, such as that on the face, or with the limbs forced into an uneasy and violent angle with the body, or such as requires its being retained by bandages; in a word, whenever there exists any additional draught on the powers of the nervous system, then the question of time should prevail over that of loss of blood, unless forced on us by the peculiar liabilities of the patient.

In operations which have entailed considerable loss of blood, the condition of the pulse should be carefully noted. If reduced considerably, so as to give indications of fainting, we should have recourse to stimulants, of which a small wine-glass of brandy diluted with about an equal quantity of water should be given, and repeated, if necessary. Brandy is preferable to wine, which is very frequently followed by vomiting. This was also the remark of Mr. Abernethy.

The second stage of the proceeding consists in preparing the wound for its final closure. But before this is undertaken, the surgeon will determine whether or not he make the attempt to heal the wound by the first intention, as it is called. If it appear to him expedient to do so, his attention must be directed to the bleeding surface, the whole of which should be fully exposed, the coagula removed, and bleeding encouraged by pressing, or even by gently wiping the suspected parts, and each vessel secured with a ligature. This stage of the operation should be effected deliberately and com-

pletely. It is difficult to insist too strongly on the importance of rendering the wound perfectly clean and free from blood, before its edges are brought into contact. Blood in almost any quantity may be considered in the relation of a foreign body, and its presence will most effectually preclude the chance of early union of the sides of the wound. By the aid either of pointed forceps, or of a tenaculum, or the instrument known under the name of Assalini's forceps, every bleeding vessel may be secured; but oozing of blood may still continue from large surfaces, in which neither the forceps nor the tenaculum is available. This oozing, though inconsiderable at the time, may become the focus of great after mischief. The influence of cold air, and the reduced power of the heart may combine at the moment to arrest all bleeding; but the act of removing the patient from the operating table, the warmth of the bed, and the resuscitated power of the heart, all contribute, in the course of a short time, to promote a return of hemorrhage unless great care has been taken to prevent it, and even this will fail, if there be a tendency to bleed from minute vessels. When this oozing prevails in a positive degree, and when it would appear that every reasonable attempt has been made to tie all the smaller arteries without success, it is better to remove the patient to bed; to leave the wound open for some hours, exposed to the air. However desirable it may be to complete the operation in all its stages at one time, and before the patient has been removed from the operating table, yet the security afforded by this practice against the necessity of reopening the wound, an evil of great magnitude, more than counterbalances its objections. The direct exposure of a wound to the air is, in my experience, by far the most efficient mode of meeting the difficulty. The application of sponges, flue of lint, pressure, all succumb to the persistent influence of cold air. The more strenuous our efforts to control the bleeding from minute vessels by local styptics, the more inefficient do these agents become; while we may rely with confidence on assuming a bold front before the enemy, and giving it apparent encouragement by indifference.

If the source of the bleeding be concealed, the wound should be laid open, a stream of cold air be directed upon it from the lungs, or even from a pair of bellows, and the coagula left untouched. A few minutes' perseverance in these means will rarely fail in arresting any form or degree of hemorrhage arising from simple causes. In cases in which a patient is seriously exhausted, and whose life is in

immediate danger from loss of blood, or under circumstances of bleeding of a specific character, of course other agents, such as powerful and destructive escharotics, actual cautery, &c., must be resorted to.

If a wound contain a coagulum of blood between its walls, it will not heal. The edge of the wound may firmly unite in the course of thirty-six or forty-eight hours, and give promise of solid union; but its after separation, for the purpose of throwing off the contained coagulum, is inevitable. This can only be effected by a separation of the edges, by which its healing action becomes exhausted, and the hoped-for union by the "first intention" is superseded by the protracted process of healing by granulation and cicatrization. Thus the date of recovery from large wounds is postponed for many weeks. Some short time after my appointment to the office of assistant surgeon to St. Bartholomew's Hospital, I was called to a case of compound fracture of the leg, in which amputation was inevitable. I removed the leg, immediately below the knee. In reflecting the outer flap, I observed that about an inch of the subcutaneous cellular and adipose tissue was infiltrated with blood that had already coagulated. Not being alive to the evil of its presence, or to the truth of the principle which I have above urged, I retained the integuments as a portion of the flap. In two days the wound appeared to have firmly united; within a week, the infiltrated integument had separated and sloughed. The end of the tibia became exposed, and the man was three months in the hospital.

In the course of last summer, I removed a small tumor, of about the size of a pigeon's egg, from the lower part of the breast of a young lady. The parts were somewhat vascular and occasioned some trouble in arresting the bleeding. Having to leave town shortly after the operation, I took additional pains in effecting this, leaving the wound exposed to the air for at least half-an-hour: finding all bleeding to have ceased, I brought the edges together, and fixed them with suture and plaster. On my return to town the following day, I found the wound distended and hot, the hemorrhage had returned, and the bed-clothes were saturated with blood. I imagine the lady must have lost at least twelve or fourteen ounces, although I had not had the opportunity of applying a single ligature. Many weeks elapsed before her entire recovery. These are cases not of uncommon, but of frequent occurrence, and they are quoted for the purpose of impressing on the mind of the reader the indispensability

of checking all tendency to the escape of blood between the surfaces of wounds, destined to union by the first intention, before they are "put up." The blood having ceased to flow, and the displaced parts, if any, carefully readjusted, no further time need be lost in bringing together the opposite surfaces of the wound, with a view to their ultimate union. In order to carry into effect this object, these surfaces must be brought into immediate and precise contact. The adhesion of the edges of the wound, however desirable, is of little moment, when compared with the importance of direct apposition of one *surface* with the opposite. Suppuration of the interior of the wound is the certain result of neglect of this golden rule, and suppuration is fatal to union by the first intention. If the sides of the wound are not in apposition, we necessarily have a cavity between them; in other words, the surfaces are exposed to air; they inflame; an abscess follows; the united edges of the surface separate, and the whole wound becomes one large cavity, which eventually heals by granulations. No doubt, as argued by Mr. Paget, in his valuable College Lectures, in which he has quoted a case of mine to that effect, the edges of a wound may heal late by granulations, after being some days in contact, when no attempt at union is made by the simpler process of the "first intention." But this is to be regarded as an exception to the rule, and not the rule itself. Unless the edges of a wound unite with some degree of firmness within twenty-four hours, they will not generally unite at all; and for the same reason, if the edges, having united, are forced asunder by internal irritation, whether caused by the presence of coagula, or by the necessary escape of matter, the union of these edges by this process is completely at an end, and the wound gapes to its base. This liability to the existence of a cavity is, of course, occasional only. In operations for the removal of the mammary gland, or for the application of a ligature around a deep-seated artery, and similar operations, this liability does not exist, because, in the first example, the integuments form a flap, which may be brought into immediate contact with the pectoral muscle; and in the second, no material having been removed, the parts naturally resume their former relations; and if they do not, it is the duty of the surgeon to bring them into that condition. But in cases of removal by excision of large tumors, burrowing among deep-seated muscles, or under the scapula, in the ischio-rectal fossa, among the adductors of the thigh, a locality rather obnoxious to their growth, or under the

superficial muscles of the calf, here the liability to a cavity is great; and the more especially so, when the opposite surfaces of the wound are composed of muscular structure, by the spasmodic action of which the healing process may be supposed to be constantly interrupted, and the tendency to suppuration in an equal degree promoted. To avoid this evil, the quilled suture was invented by the old surgeons, before the time of Dionis, by means of which the opposing surfaces were brought into contact at some little distance below the outer edge. But it is an inefficient antidote to the evil, by reason of its possessing so limited an influence on the wound below it, unless it implicate the entire surface. The object can only be efficiently

Fig. 6.

attained by the force of external pressure, carefully applied to the skin at a distance beyond the wound. The immediate agent employed is either soft lint of folded, or what is termed by the French school, *charpie*, or masses of soft cotton wool. The pressure should be large and wide, not necessarily limited to the size of the cavity, but extending beyond it, on all sides.

When the edges of a wound can be readily brought together without effort or stretching, and are well supported by the parts underneath and the expanse of surface is considerable on both sides, such as occurs in wounds on the surface of the trunk, thigh, or neck, good adhesive plaster will render the resort to sutures unnecessary; but it must be

good; it should be recently made, and, unless in cold weather, it should adhere to the surface without the application of heat. One broad strip should pass across the middle of the wound, and extend some inches beyond it, in each direction, care being taken, on applying it, to adjust the edges of the wound together. The remaining strips may be narrower, unless the wound be a very large one; but it is better to leave two or three small intervals between the strips for the oozing of blood or other discharge. The wound should not be overloaded with plaster, which is required for no other purpose than that of keeping its edges in contact, and to this end one thickness of good plaster will suffice.

When the edges are brought together with an effort, and the surface below cannot afford an entire support to the flaps, as in amputations, we have recourse to sutures, as also when the flaps are very loose, and not easily adjusted to each other; sutures also are quite requisite where two or three flaps are brought to meet in a point. This we occasionally find in Taliacotian operations. After all operations, except those on the face, and the exposed parts of the neck and chest in women, the bringing into a general contact of the opposite surfaces is all that is required. Of the above exceptions I shall speak more at length hereafter.

In wounds of the trunk and limbs, and also in amputations, two or three sutures are sufficient; the intervals may be two inches or more in length, and these intervals should be occupied by plaster. The precision and exactness of the union, and the breadth of the cicatrix, are comparatively of little moment, and yet some care should be bestowed that the apposition of the two surfaces be tolerably perfect. The only excuse for negligence in carefully adapting the two surfaces together, is obtained from the fact of the time that will be occupied in healing the wound, even under favorable circumstances, which the partial healing by granulations on the surface will but slightly prolong.

There are various forms of sutures employed in surgery. The office of a suture is that of ensuring a perfect contact of two opposing edges. The form of suture employed will, however, depend on the nature of the edges, the depth of the wound, &c.; for, as has been already observed, it is needless to attempt the approximation of the upper edges of a wound, unless the deeper parts and base are also retained in precise contact.

"The uninterrupted suture" is applied by uninterrupted sewing,

one continuous thread being passed through the opposite edges of the wound, and drawn tight. It is a coarse and painful agent, and possesses this decided objection, that when divided in any part, the whole becomes loose, and is no longer serviceable in any part. The common, or interrupted suture, is a great improvement upon it, because the degree of tension of each part can be regulated, or partially removed at will. The necessity of watching each part of a wound in the progress of union renders it very necessary that we retain full command of the individual sutures, some of which may require early, others later, removal. This important object is precluded by the use of the "uninterrupted suture," which is rarely resorted to in the practice of eminent men, whether in England or on the Continent. It is, however, occasionally employed in wounds of the intestines. In the common or interrupted suture, the thickness of the thread employed is determined by that of the substance intended to be brought into contact, and the force requisite to effect this object. We cannot rely on the efficiency of a fine thread if force be required, because the thread would cut itself out by absorption, and the employment of a coarse thread would be equally ill-selected for a small wound, requiring an exact contact. It appears to me unnecessary to dwell on this subject, or to attempt to lay down any precise rule. I content myself with enforcing the principle, that the opposite surfaces of a wound must be brought into absolute contact, and that we cannot safely rely on the aid of any but a thick suture for a deep wound, by which the edges are well supported, and which suture would be most unsuitable to a wound through the skin, requiring a neat and perfect adjustment.

The "glover's suture" corresponds to that form of stitch employed by sempstresses, which is termed "herring-bone." It is rarely or never employed on the living body, being reserved exclusively for the arcana of the dead-house, where it is highly serviceable, and from which we obtain no testimony to any objections that might otherwise be urged against it.

I know no objection, commensurate with their value, to the application of sutures, in any part of the body, whether on the head, trunk, or limbs, nor to their including any structure, whether cutaneous, cellular, fibrous, or even muscular. They are certainly of little value when employed to retain in apposition a *transverse* cut through a muscle, unless the muscle be thoroughly relaxed. I am aware that some eminent members of our profession entertain an

objection to the application of sutures on the scalp, and, perhaps, it is fortunate that the nature of the wounds in the region is such as to enable us to resort to the use of plaster with equal advantage. I cannot say that my experience justifies this apprehension. I have repeatedly employed them in every form of scalp wound.

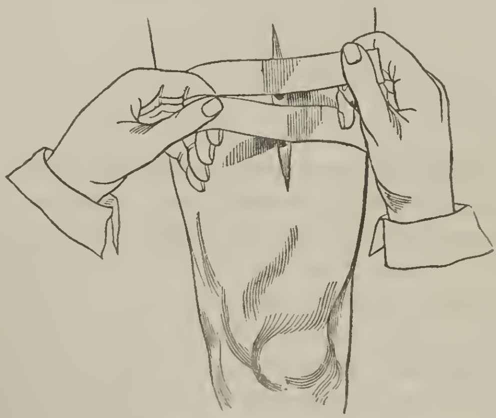
Wounds on the face, in both sexes, or on the neck or upper part of the chest, in women, require more consideration. The duty of the surgeon consists in exercising his best art in concealing deformity; and it should not be forgotten that in the face, the seat of expression, the slightest defect or deformity becomes apparent to common observation. It is within the range of our art to unite a small wound with such precision as to escape detection; but the manipulation must be perfect, and the care the greatest that can be bestowed upon the case.

Fig. 7.

Young persons, some years under puberty, possess this advantage, that scars from wounds occasionally wear away, and at sixteen or seventeen years of age, they are often obliterated. Many years ago, a young girl was brought into St. Bartholomew's Hospital, who had been bitten by a dog about the face, neck, and extremities. The dog, in full conclave of the medical staff, was deemed rabid, and the parts were all excised, partly by the late Mr. Earle, and partly by myself. Each wound was carefully dressed. The girl recovered and became a nurse in the ward. Five years afterwards I examined her, and not a vestige of her wounds was apparent. If a scar be left on the face consequent on an operation, or on the surgical management

of any clean wound, the blame will generally, and often justly, rest on the surgeon. The wound should be carefully freed from its blood, and rendered perfectly dry. The edges should then be brought in exact contact, if necessary, by the finest suture. This necessity will depend on the form of the wound, as well as on its situation; for if in the angle of the nose, or in the immediate neighborhood of the mouth or eyelid, the efficient application of plaster will be made with difficulty. I employ, both in ordinary and in Taliacotian operations, the finest needle, slightly curved at the point, with silk thread to correspond; of these two or three may be introduced, or even more, should the length of the wound justify it. The puncture with the needle should be made at not more than a line's breadth from the edge of the wound, brought out in the wound, and again introduced, its point finally appearing at the same distance on the opposite side. All, or several of the sutures should be passed through the wound *before any of them are tied.* But intervals may yet remain between the threads, and, as before on the larger scale, so these intervals should be occupied by narrow strips of plaster, of which the best common adhesive plaster of our hospitals is preferable to any. Mr. Liston had a great predilection for isinglass plaster, but, in my opinion, it has positive demerits. It fails in giving the support obtained from the common adhesive plaster spread on linen. It certainly presents a very clean appearance, but it is required to be

Fig. 8.



fresh when used, for the important purpose of retaining together large surfaces, and is comparatively expensive for any other. I

can purchase no plaster superior to that used in St. Bartholomew's Hospital. Of this plaster two narrow strips should be cut, and warmed, if necessary, and each should be applied, by one-half of its length, to the opposite surfaces of the wound. When thoroughly adherent, the other ends of each strip should be drawn simultaneously, but slowly, across the fissure, and as soon as the edges are brought into perfect contact, and *even drawn closely and pressed together*, the plaster should be fixed on the skin beyond, and the object of perfect apposition is attained. There is no reason why this mode of applying the strips of plaster should not be adopted on all occasions in which it is desirable to effect an exact apposition.

This union of the opposite sides of the wound will leave little or no cicatrix, if it progress favorably. The principle of this junction of two living surfaces is distinct from that of the "first intention," which is effected by the organization of interposed lymph, poured out by the vessels of each surface, for the express purpose of filling an interspace. Here there is no interspace, but vessels simply shoot across, and unite the two into one. The union by the first intention is indirect; this is immediate, being perfected in the course of twelve or eighteen hours. This process was first described by Mr. Paget, and to it he applies the term "primary adhesion."* I had often suspected this mode of healing, though I had never verified the fact, for it would seem impossible that lymph could be poured out between two surfaces forcibly brought into perfect apposition with each other.

It is to be regretted that we have it not in our power more frequently to avail ourselves of this valuable principle, in the *vis medicatrix;* but there is no reason why we should not make the attempt, and from which no evil can, and much benefit may, arise. Taliacotian operations, for obvious reasons, require the exercise of peculiar care and precision in the adjustment of their opposite surfaces, the further reference to which will be considered more at length under that subject.

I have hitherto confined myself to remarks on the subject of clean wounds made with the knife; but a different proceeding is often required in lacerated wounds, especially on the face, where it is obviously so necessary to make the attempt to restore the injured surface, as much as possible, to its natural appearance. The edges

* See College Lectures, by James Paget, for 1849.

of such a wound, caused by violence, may be more or less jagged and irregular. In non-exposed parts of the body, the nature of the union leaving, as it necessarily will do, a broad and irregular cicatrix, is of no moment, provided it be completed; but when occurring on the face, it demands more attention, and every means should be resorted to, with the consent of the patient, or the parents, if in the case of a child, to unite the wound so effectually as to prevent the deformity of a future scar. The resources of operative surgery may very properly be resorted to in converting the ragged into a clean edge, which shall be made perfectly to correspond with the opposite one.

The union of two ragged edges of a wound, however perfectly effected by the first intention, will leave a scar, by which the features of an otherwise beautiful face may be deformed for life. It is the duty of the surgeon to endeavor to prevent this evil by assimilating the wound as much as possible to that made by a clean cutting edge. To accomplish this, a portion of the skin should be sacrificed. As much should be cut away with a sharp knife as will get rid of the entire ragged portion of the wound, and continued until the opposite edges be capable of being brought into perfect apposition. The same necessity would apply to wounds infiltrated with dust, or dirt, or fine gravel, the presence of which would preclude the chance of union either by primary adhesion or by the first intention. All the integument so involved should be carefully removed with the knife or scissors; almost however large the portion, for otherwise it will probably slough. If the dirt can be dissected from off the inner surface of the skin, leaving the latter still forming its continuous surface with the surrounding integuments, it will be a great point gained; but in the form of injury alluded to, the entire skin is generally more or less involved throughout its substance. If so large a portion of skin has been removed as to render the approximation of the two surfaces difficult, if by the introduction of a suture, (for the use of the forceps for such a purpose is inadmissible,) a space remains between them, the two surfaces should be separated with a fine knife from the subcutaneous tissue, and converted into flaps, the extensibility of which will readily admit of their being brought into contact. The wound should be carefully cleaned, and the edges united by one, two, or three fine sutures, and their interstices occupied by yet finer silk, passed through with a needle not larger than the finest sewing needle, and somewhat

curved at the point. The former may include the entire substance of the integuments, while the latter, involving a depth of less than a line, should unite the opposite sides in the proportion of about four, five, or even six, to every inch.

Lacerated wounds are often attended by extensive separation of the integuments, or the integument itself may be involved in the laceration, forming a large flap, infiltrated with dirt, and extensively separated from the surrounding skin. The question arises, what should be done with a flap so circumstanced? Should it be entirely removed, or an attempt made to retain it? If it be disorganized, or nearly so; if the subjacent substance be also injured, and if the flap be nearly insulated, it should be removed, and the surrounding integuments brought forward by every means, to supply its place; for it is better to remove integument that will in all probability die, than to leave it to slough. As a general principle, however, the integument is too valuable an agent in the economy to be disposed of, without good and sufficient reason, and, with the above exception, it should be invariably retained; for, although a portion may slough, the vitality of the remainder will form a natural investment to the living parts beneath, and greatly abridge the duration of the healing process. Great care should be taken in effecting the closest apposition between it, and the structures beneath and around, and this is to be obtained by applying over the surface a quantity of soft lint, or other material, rolling the part pretty firmly with a calico roller, and uniting the flap as generally as possible with the healthy integument around, by means of sutures.

The after dressing of a wound resulting from a capital operation, is a subject of no slight importance to the issue of the case, and proportionate skill and care should be bestowed upon it. It is presumed that every requisite attention has been paid to the comfort of the patient, both mentally and bodily, and that every source of irritation has been carefully avoided. As rest and perfect quietude are so indispensable to the healing process, some attention should be bestowed on the position of the patient while in bed; the position being selected in reference not only to the comfort of the patient, but also to the necessities of the surgeon in dressing the wound. The first question relates to time; under usual circumstances, of large wounds especially, as after amputation, two entire days may be allowed for union, before the wound is exposed; but, although this rule may be generally resorted to as a safe guide, yet it is subject to modifica-

tions from sundry causes, of which the following are among the most prominent: 1st. Distension of the wound from hemorrhage during the first six hours after the patient has been placed in bed; or indeed discomfort from any local cause. 2d. Fetor perceptible through the dressings, a no infrequent indication during the height of summer. 3d. The great probability that the process of healing, either by primary union or by the first intention, has failed, often indicated by a tinge of inflammation on the edges of those parts of the wound readily exposed to the eye. Either of the above conditions justifies dressing as early as the thirty-sixth hour, or even earlier, but as a general rule, forty-eight hours may be allowed to pass with safety, and in some cases, such as hare-lip or fissured palate, from four to ten days, or longer.

For this secondary operation, every preparation should be carefully made, and the most delicate manipulation employed by the surgeon. A good light should be insured, sponges, hot and cold water, plaster, already cut into strips, everything should be in a state of preparation as exact as though required for the operation itself. The wound should be partially exposed by the gradual removal of the old strips, which should be effected by raising each end from the skin, towards the centre, in order to prevent separation of any portion of the uniting wound by drawing it asunder, and detaching the new adhesion. If the old plaster adhere to the fine hair of the skin, it should be detached slowly by pressing the finger close along the line of its separation, and rather by pressing the skin from the plaster, than by drawing the plaster from the skin. It is often advisable to shave the fine hair thus involved, or to cover it permanently with plaster, at the time of the operation. As soon as a portion of the first plaster is removed, the surface should be washed, or rather bathed with tepid water, and a fresh strip should be applied, either in one breadth, or divided into two, and simultaneously applied in the manner already described. This will depend on the degree of *dragging* to which the wound is liable from position or other causes. Other portions of plaster may then be successively removed, and fresh plaster applied as before.

Having alternately exposed piecemeal the entire surface, we shall be able to form a tolerably correct opinion as to its internal state, and to determine how far we can rely on the hope of union by the first intention. If its edges are pale, and not marked by a blush of inflammation, if the wound be free from pain, and dry, and not dis-

tended, and the margins do not separate and retract on removing the plaster, an important step towards its recovery has been taken, and the critical stage is passed. But if the converse of these conditions hold—if sanious fluid oozes from the cavity—if the margins be discolored with an inflammatory tinge, and separate on carefully removing their support—if the lead contained in the plaster be acted on by the sulphuretted hydrogen evolved from the wound, we have then too much reason to infer that the process of union has been arrested, or at best but partially effected. By this knowledge, which may always be attained with some certainty, the new dressing should be greatly modified. If, at the expiration of thirty-six or forty-eight hours, the wound present the characters above described, it is obvious that we cannot hope for early union, and certainly not for union by the first intention. Under these circumstances, the sutures should be removed, and the wound thoroughly cleaned by means of a current of warm water repeatedly squeezed from a sponge. Great care should be taken throughout the dressing to maintain whatever union has been effected, by retaining one or more pieces of plaster upon it.

I have often heard the above inflammation of the surrounding skin referred to the presence of the sutures. I greatly doubt the soundness of the inference. The inflammatory condition of the skin is simply an indication of what is passing in the wound: for when the wound is shallow, or not very extensive, we do not so frequently observe that symptom, which is common enough in amputations, or in wounds made for the removal of large tumors. Moreover, we usually find the absence of union over the almost entire surface in such cases, which, if dependent on the sutures, would have failed to unite at the surface only. The sutures should be removed, the rather that they are no longer available to any useful purpose, and they may, and probably will, aggravate the evil already commenced. In this condition it is useless to attempt to bring the sides together with any hope beyond that of preventing further separation. The plaster becomes therefore a passive rather than an active agent, and its application may be limited to the extremities of the wound, the interval being occupied with water-dressing, or a light poultice of linseed, with which chloride of lime may be combined if the edges of the wound show any tendency to slough, and the fetor be positive. After the first dressing, whatever its condition, the wound will require its repetition daily.

One of the most remarkable relics of the barbarous surgery of the

past age is the universal employment of poultices, whether of bread or linseed meal. Indiscriminately used to all surfaces, whether exposed or otherwise, I believe there exists a formidable balance against them; but when carefully made and employed with discrimination, they are not without their advantages. What application could be selected productive of more discomfort to a wound than a large thick mass of half-dried linseed meal of the weight of from one to two pounds, and this upon an exposed and sensitive surface; or similar masses of half-crumbled bread, which latter, employed on the surface of the person of a child, or even on that of an adult, almost invariably produces pustular eruption?

Poultices are objectionable on exposed surfaces, and more especially when applied thick. They were most properly denounced by the late Mr. Liston, and exploded from his treatment; and yet, when well timed, and well made, no kind of application is more suitable. Their employment should be restricted to the outer skin, or occasionally to healthy granulations. They should be made light, smoothly spread, and if a small quantity of any simple unctuous substance, such as oil or lard, be combined with them, no material is more efficacious in maintaining a uniformity of temperature of the surface, or is more cleanly in its operation, than a linseed poultice. But they are often unsuitable to a raw surface, or even to a raw edge. As a dressing to an ulcer, or to most forms of open wounds, they are less efficacious than the water dressing, made by the application of wet lint or linen, the moisture of which is retained by a covering of oiled silk. They are inferior to raw cotton as a dressing in small or large sloughs, such as those occurring in bedridden people. But as an application to an advancing or a discharging abscess, or to a painful joint, as employed by Mr. Abernethy, they have, in my opinion, no superior. The idea formerly prevailing, that they possessed stimulating properties, and the vulgar notion, that they exert a drawing power employed for the purpose of bringing a foreign body to the surface, is long since exploded by all reflecting men.

In cases of fetid wounds, we occasionally resort to the addition of carbonaceous matter; such as powdered charcoal, combined with bread-crumb, or yeast, carrot, &c. I have no great faith in their value, but I believe they are occasionally found serviceable, and certainly possess a claim to notice, as being retained in the practice of eminent members of our profession.

When an abscess under the skin has reached its period of maturity, the matter should ordinarily be evacuated, either by puncture or by incision. The selection of the one or the other of these two modes will depend on the size of the abscess, on its degree of maturity, and on the constitution of the patient. The difference between the two modes of operating consists, in the first, that of withdrawing the instrument employed through the orifice by which it was inserted; and in the second, that of enlarging the wound beyond the breadth of the instrument, by incising the wall of the abscess to a greater or less extent. If the abscess be large, it is highly probable that the process of suppuration will continue after the matter has been removed; therefore, it is not expedient to rely on a mere puncture, unless with a very broad instrument, lest the outer wound close, and a second opening become necessary. If, in the case of large abscesses of a chronic form, we evacuate the contents, or a portion of the contents, the incision should be only sufficiently large to permit the contents to pass through, and the wound should be carefully united.

In every common phlegmonous abscess of the subcutaneous tissue, there exists a stage of progress towards its consummation, a stage of maturity, and a stage of absorption of the material composing the walls of the abscess next the skin. If the matter be evacuated during the first stage, the suppurative action is not exhausted, the outer wound will readily heal, and the suppurative process will continue uninterrupted. The period of maturity of the abscess is, by this untimely operation, postponed probably for some days, in consequence of the cyst having been partially relieved of its contents. This is the general history of small abscesses, which, having been ineffectually punctured by patients themselves, and relieved for the moment, regain their former energy, and ultimately demand the aid of the surgeon for their permanent cure.

The third stage is characterized by thinning of the cutaneous wall, which, congested with blood, becomes every day less amenable to the healing process, and if the abscess has long passed its period of maturity, the integument when divided will shrink, or become absorbed, and an ulcer will succeed. This also is the history of the frequent extensive ulcerations in the groin, found in the venereal wards of our hospitals, in which either the abscess has been brought to a crisis at too late a stage for the recovery of the integuments, or has been allowed to burst through the attenuated skin, without the

aid of the knife. In this latter stage, an incision, large in proportion to the size of the abscess, should be made along its long axis. Of late years the vertical direction is recommended for division of abscesses in the groin, although the axis be transverse. This practice is, I believe, universally adopted by Mr. Lawrence.

The second stage occupies but a brief interval, and is characterized by severe pain, fullness, and discoloration of the skin increasing up to the centre. If the health be vigorous, and the constitution sound, and the precise day or even hour well selected, a simple puncture, that will permit the escape of its entire contents, will generally suffice for the cure. For a mere puncture, a large common lancet may be employed; for an incision, which is much more frequently required, either a fine straight knife, or an abscess-lancet is preferable. The point of the instrument should be introduced at half the length of the projected incision from the centre, and carried rapidly across to a corresponding point on the opposite side. When the wound is small, it is generally desirable to introduce a few threads of lint into the cavity, to prevent its union by the first intention, and by which a second operation may be rendered necessary. Collections of matter occurring in weakened constitutions should be generally opened early, to prevent the abscess degenerating into an ulcer, the frequent consequence of thinning of the entire cutaneous wall from the absence of sufficient power to make it point.

Associated with the subject of simple wounds, and the necessity of arresting hemorrhage, is that of ligatures, on the nature of which some few remarks appear to me necessary.

The experiments of Dr. Jones have long since proved that ligatures employed for tying arteries, whether applied in the course of an artery or on open vessels, divided in operations, should be firm, round, and unyielding. They should be sufficiently strong to permit a force of tension requisite to cut through the two internal coats of the vessel and something more; for as it is impossible to regulate with exactness the force of tension required, which is always a little exceeded by the hand, so the ligature should possess such strength as will give confidence to the surgeon in applying it, but beyond this point strength is needless. There is no comparison between the force required to cut the internal coats of any artery, large or small, and that which the hand may exert on such occasions as compel the putting forth its entire power.

The value of a ligature, therefore, is not enhanced by its power of resistance to our strongest efforts to break it; for such a force can answer no useful purpose when applying a ligature around a wounded vessel, where the sensation of yielding of the coats is all that is wanted, and all effort beyond this, waste of power. Want of strength may always be supplied by the dexterity of the hand applying them, on the principle that the shorter the part of the ligature between the fingers, the greater its resistibility.

In applying a ligature on a vessel, the thumbs should be pressed downwards on the thread closely in contact with the artery, and little more than the diameter of the vessel should interpose between them. When the first half of the knot is tied, the act should be accompanied with a slight sawing movement of the hand, to insure the fullest degree of tension.

If the two thumbs, brought into contact at the knuckles, be applied on the thread close to the knot, and the small lateral movement above alluded to be adopted, the two internal coats will be divided with a very slight exertion of power by the hand, and this is all that is required. If necessary, the first half of the knot formed by a simple crossing of the ligature should be retained with a pair of fine forceps, to prevent its slipping; but when the ligature is wet, this seldom occurs, and the knot should be then completed. If it be intended to close the wound, in the hope of union by the first intention, one end of the ligature should be cut close to the vessel, and the other drawn through the outer wound. If this attempt be hopeless, and the wound be left to granulate, the two ends may be cut close to the vessel.

Connected also with the subject of wounds, and incidental to the occurrence of local injury, whether the result of accident or of surgical operation, is that of tetanus. Tetanus is an affection of the nervous system, in which the muscular frame becomes the seat, first, of spasm, and, secondly, of permanent and painful contraction. This horrible disease manifests itself by a sense of stiffness in the muscles of the jaw, which is occasionally mistaken for rheumatism. As it advances, the muscles of the back of the neck, back, chest, abdomen, and, finally, the extremities, become involved in one universal cramp. Each muscle is raised into a hard, rigid swelling; fixing the body immovably, and producing excruciating pain. Hour after hour but adds to the extent of the parts involved, and to the intensity of the disease, till death puts an end to the patient's suf-

5

fering. This crisis occurs on or about the third or fourth day from its first appearance. In some cases, and not the least severe, the spasm is nearly confined to the head and trunk, the extremities being left tolerably free.

Occasionally we find strange and unaccountable remissions of the symptoms; and patients have been known to rise up from bed, believing the disease to have left them. But it is rarely that tetanus ends but with the death of the affected person; though, like some other affections of the nervous system, a temporary but most deceptive lull of all the symptoms is followed by their sudden recurrence, and death ends the struggle.

Every remedy that ingenuity could devise has been more or less fruitlessly applied to arrest the progress of this fatal malady. Depletives of all kinds, purgatives, narcotics, antispasmodics, sedatives, counter-irritants, all have failed. Here and there a case of partial success, and even of complete recovery, gives a temporary eclat to a new remedy. Of all these agents, perhaps opium is the best, but it must be administered freely, and without fear. The largest doses alone afford any chance of benefit. To trace the already well-trodden ground of past experiment, is to trifle with human life, and to exhibit a pusillanimity of conduct unworthy a profession that daily enters into the contest with death. Better that the patient die under opium than under tetanus. I have recently witnessed the dying pangs of a fine young officer, who, in taking a loaded horse-pistol from his carpet-bag, accidentally struck the trigger, and the ball passed through his hand. I removed the third finger and metacarpal bone. The wound progressed well, and was rapidly healing with florid and healthy granulations, when, as late as the twelfth day, tetanus appeared, with spasm occurring about every minute, in the right serratus magnus muscle, and pain around the origin of the diaphragm. The disease had existed, though slightly, for twenty-four hours, when I was called to him. In conjunction with Mr. Lobb, I ordered him forty drops of laudanum every two hours, and the pain remitted. In six hours it returned with more violence in the same regions. His pulse was 130; his countenance betokened intense suffering; his breathing was rapid, and he sweated profusely. I ordered him chloroform occasionally through the night. This agent was administered twice, and each time with great temporary relief. On the following morning, he was yet more suffering; pulse 140; jaw fixed, but not closed. Intense pain in the chest and back

of the neck. I administered chloroform, and requested it might be used continuously till the hour of our next visit. The instant he was brought under its influence, *he sank back into a tranquil sleep, and his pulse and breathing fell to their natural standard.* He appeared perfectly free from disease. In this condition, constantly plied with chloroform, he remained, without the intermission of a moment's suffering, for six hours and a half. The instant he awoke the enemy was at hand, and he screamed with agony. He had an enema of turpentine, and his back was blistered. At the imprudent request of an attendant, he put out his tongue, and the jaw closed upon it, and would have severed it in two, but for our assistance in wedging the teeth asunder with the handle of a spoon, the first instrument at hand. His death was now certain, and I resolved he should die under chloroform, which was again administered for thirteen hours without remission! The drug then failed us; he became so tolerant of its action, or, perhaps, his sufferings were so great, that the pains gained the ascendant, and he died in torture in forty-two hours.

In this case, I think I may be said to have fairly tested the merit of anæsthetic agents, which are invaluable in their power to arrest suffering, but possess not the slightest power in contending against the disease itself. Should another case occur to me, I should be disposed to apply the actual cautery freely under chloroform, along two-thirds of the length of the spine. I had no hope of benefit from amputation of the arm, though I learn that Mr. Bransby Cooper has amputated with advantage. The question might have been raised had I seen this patient at the date of the first symptoms, which advanced very slowly for the first thirty-six hours. Of one thing I feel very certain, that the administration of any agent that promotes weakness ministers to the disease.

CHAPTER III.

ON DISLOCATIONS.

OBJECTIONABLE NOMENCLATURE EMPLOYED IN REFERENCE TO DISLOCATIONS.—PRINCIPLES OF REDUCTION.—INFLUENCE OF MUSCLES IN PREVENTING REDUCTION.—INFLUENCE OF MUSCLES IN EFFECTING REDUCTION.—COMPLETE AND PARTIAL DISLOCATIONS.—EARLY REDUCTION MOST READILY EFFECTED.—PERIOD AT WHICH REDUCTION MAY BE ATTEMPTED IN OLD DISLOCATIONS: 1. INORGANIC CONTRACTION OF MUSCLES.—2. FIBROUS ADHESIONS.—3. FIBROUS SUBSTANCE OCCUPYING SOCKET.—GRADUAL EXTENSION.—APPLICATION OF AGENTS OF EXTENSION.—OBJECTIONS TO APPLICATION OF EXTENDING FORCE TO THE DISLOCATED BONE.—EVIDENCE OF REDUCTION.—SPECIAL DISLOCATIONS.—DISLOCATION WITH FRACTURE.

By the term dislocation, is understood a displacement by violence of any part of the osseous components of a joint from the remainder. The word, however, is illogically, but too frequently applied to the joint itself, and the only justification of its use would be a displacement of the entire joint in relation to the rest of the skeleton. Thus we speak of dislocation of the ankle, instead of that of the foot; dislocation of the elbow, instead of that of the ulna or radius. The shoulder-joint, for example, is composed of the humerus and scapula. If we employ the term "dislocation of the shoulder," we *should* mean dislocation of both bones from the chest, but we *do* intend to express simple displacement of the humerus from the scapula. The objections to this false nomenclature are greater than the nature and objects of this work admit of the further exposition. A joint is the seat of dislocation, when any of its bones are separated from the rest by displacement; and looking alone to the cause of the injury thus sustained, we are justified in applying the term dislocation to the bone only that is displaced, viz., that which is the more remote from the trunk. Dislocation of the foot is the result of violence directed against the foot itself, and not against the leg.

Dislocation of the humerus is the result of violence directed against the arm, and not against the scapula.

A good knowledge of the subject of dislocations should be possessed by every surgeon, for there is no accident, the ill management of which more frequently leads to discontent and litigation than this. Although the symptoms of the majority of dislocations are palpable, and cannot be mistaken by a person of average observation, yet many are very obscure and intricate in their signs, and require long study and careful examination, before a decided opinion can be formed as to their nature. No surgeon is exempt from this responsibility, and in order to facilitate his decision, the bones of the extremities at least should form a part of the apparatus of his surgery ; a glance at which once or twice in the course of every year would prove not unprofitable.

Before proceeding to the description of dislocations in detail, I am desirous of commenting briefly on the subject of the principles which ought to guide our management, and in which I propose to combat certain opinions, and a generally adopted practice, that, in my judgment, are erroneous.

The affected bone is dislocated from its socket, generally, in consequence of the violence of a blow it has experienced. It remains dislocated, in consequence of the tension of the muscles inserted into it, which become the subject of a passive contraction. This state continues, so long as the limb remains undisturbed by the efforts of the surgeon to reduce it. But no sooner is the attempt made to elongate the limb than the same muscles, one and all, start into sudden and positive contraction, as though for the express purpose of preventing the descent of the bone. In this unequal struggle, they contend against the yet more powerful agents of traction by pulleys, yielding their ground inch by inch, till the bone is restored to its normal position, when they retire from the contest, and instantly resume their former state of repose. In the case of the dislocation of a large bone, the power exerted by the muscles, in order to retain it in its false position, is enormous, as may be readily inferred from the force employed to counteract them ; and this force is also continuous throughout the whole period of the attempt at reduction ; their contractile power becoming probably greater as the bone descends, and approaches the range of the ordinary contractility of its muscles.

It does not appear very reasonable to suppose that a force like

that employed to reduce a bone, fixed by some of the largest muscles in the body, and often reaching that of several hundred weight, could be diverted from its straight line to any useful purpose by the mechanical pressure of the hand, or even rotated by the unassisted effort of one, or even of two, persons. Yet surgeons often take credit to themselves for reducing the bone by such manœuvres; such as rotating the femur inwards, after extension of the limb, for the purpose of raising the head of the bone into its socket, or raising the head of the humerus in like manner, in dislocation of that bone downwards, into the axilla. An experience of twenty-five years of every variety of dislocation, in St. Bartholomew's Hospital and elsewhere, long since taught me the futility of such attempts, and I am strongly of opinion that the apparent success which occasionally, *though rarely, attends them*, is due to accident alone. If the head of the femur, for example, be drawn down insufficiently, so that it rests on the outer margin of the brim of the acetabulum, it cannot be pushed over this margin into the socket by any act of manipulation, for additional extension is still required; whereas, if it has reached the requisite point, it will be instantly reduced by its own muscles.

I have repeatedly inquired of the most experienced surgeons in the metropolis, how frequently they had witnessed the successful result of such attempts to replace the bone in its position. The answer has been invariably such as to justify me in adopting the principle I wish to urge on the attention of the reader, viz., that the immediate act of reduction is effected by the muscles, and by them alone. Remove the obstacle, bring the bone downwards, and the socket will receive it with avidity, by the agency of its own muscles, which it would appear are more powerful in a good than in a bad cause, and which now contend more successfully against the extending force employed, even at its highest degree of traction. Such is the result of my observation. I have rarely witnessed an act of successful interference by a bystander, whereas I can bear my testimony to upwards of a hundred ingenious, though futile, attempts to enhance the value of simple extension by side-towels, lateral girds, violent twistings of the limb, and sudden cessation of the extending force; formerly most agonizing aggravations of the sufferings of the patient, and all to no purpose, because the extension is either misapplied, or is insufficient to such necessary elongation as can alone overcome the obstacle to the reduction.

The occasional occurrence of difficulty from the obstruction of a muscle or tendon, which has become twisted from its position, and has prevented the return of the head of the dislocated bone into its socket, is an exception, and an infrequent one, to the above rule; and it cannot be denied that success does not invariably attend the best made efforts at reduction, and that the obscure and mysterious cause of this difficulty remains for ever unsolved, however perfect may be our knowledge of the anatomy of the parts involved in the dislocation.

In the endeavor to reduce a dislocation, the line of traction should hold reference, less to that of the socket, or surface from which the bone has been displaced, than to the more important purpose of easing it from the surface on which it has lodged. For example, the rim of the glenoid cavity, in dislocation of the humerus, presents an obstacle to the extension of the bone in the immediate line of that cavity; but if the bone be drawn off it, by extension made in any oblique direction, the instant this ridge is passed, the head will rush back into its natural cavity. So, also, in dislocations of the femur on the dorsum ilii, we do not attempt to draw the bone in a direct line with the acetabulum, but we carry it below, round its back and elevated margin, and no sooner does it reach the lower part of the rim, which is much less prominent than the upper and back part, than the muscles immediately restore it to its socket. The same rule holds in dislocation of the ulna and radius backwards, at the elbow-joint. I believe the exact line of extension to be much more readily determined, and in truth a less important subject of consideration, than it is generally deemed. I believe that if we bring the bone sufficiently downwards, and place it in the *neighborhood* of the articulation, the muscles will replace it with as much ease as that which originally dislocated it.

The bone appears, as it were, sucked violently into the socket, even at the instant of its sustaining the greatest force of extension. Then is it that the muscles, acting with one accord, set at naught the extending power, and complete the work of reduction, in defiance of all the agents employed at the moment to prevent it. I consider that the muscles are the immediate agents of reduction, and not the surgeon, whose entire duty consists in placing the bone in a position to give them the opportunity of displaying this harmony of action, and of exercising a power even beyond that of the mechanical agents of extension. It is this power that succeeds in

forcibly drawing backwards the head of the femur into its cavity, when it has fairly reached the rim of the acetabulum, notwithstanding the force employed at that instant in extending it. In the examples of the larger dislocations, I place no reliance on any of the above-mentioned efforts of manipulation, but depend, almost entirely, on the act of simple extension, in the fullest confidence of the disposition of the joint to right itself if the obstacles be removed. Mr. Vincent, the late senior surgeon to Bartholomew's Hospital, in his work on "Surgical Practice," takes the same view of this subject. He says, "The object to be aimed at is to bring, as perfectly as can be, the head in that situation in which the muscles can all, with one consentaneous act, draw the bone into its place in the socket."

A dislocation, in surgical language, may be partial or complete; that is to say, that in articulations presenting an approach to a flat surface, such as the condyle of the lower jaw with its cavity, the lower end of the tibia with the astragalus, and all the arthrodial joints, such as those of the carpus and tarsus, the displacement may be more or less complete. Of this equivocal form of injury, no better example need be cited than that of the ankle-joint, in which the foot may be thrown out of its relation with the tibia so slightly that the opinion as to the actual occurrence of displacement shall obtain the tardy affirmative of at least one-third of the authorities viewing it, notwithstanding abundant collateral evidence of severe injury. In considering this subject, we should not restrict our observation to the imperfect adaptation of the new surface to each other, but extend it to the muscular power which retains them in their new position. These muscles are actuated by every motive to prevent the slightest movement of the limb. The agents of flexion and extension, being well balanced against each other, are now for the first time enlisted in the same cause, viz., that of fixing the foot, whatever its position, firmly against the tibia. The same observations will apply to the jaw, which may be dislocated on one side, and not on the other, and to other joints. It is remarkable how slight a degree of displacement of bones, having surfaces ill adapted to each other, may be maintained by the harmonious action of the muscles inserted into or beyond them.

It is desirable that an attempt to reduce a dislocated bone be made as early as possible. The difficulty increases daily, by reason of the increasing inorganic contraction of the muscles engaged, and

after the expiration of some weeks, by the new fibrous adhesions which the dislocated bone acquires. But this difficulty should not be overcharged. It does appear probable, that an attempt at reduction, immediately consequent on a dislocation, takes the muscles by surprise, and the object is attained with a facility that does not reward, with equal success, the same means employed even a few hours afterwards. But, supposing this rare opportunity lost, I am doubtful whether the difficulty increases in any positive degree, day by day, for some time. I do not deny that the passive contraction of the muscles demands an increasing force of extension by the mechanical agents employed, but I consider the progress of this difficulty to be so slow as not to present any serious obstacle to the elongation of the limb by pulleys, or by similar agents, even though many days, or even weeks, have expired since the occurrence of the accident.

It is impossible to lay down any positive rule with regard to the time beyond which an effort at reduction should not be made, unless we carry the question at once into a period of nine months, or a year or more; because, although our success may be improbable, the attempt is worth making, provided it be carried into effect with discretion, and it is very rarely that injury is sustained by the attempt, however powerful or long continued; indeed, it is often followed by increased freedom of movement afterwards. Sir A. Cooper objects to the efforts being made to reduce dislocations of long standing, and he has endeavored to define the period at which the attempt may be made. He gives two months to the humerus, and three months to the femur. It would appear that the increase of difficulty in the attempt to reduce a bone dislocated three or four months arises rather from the increase of strength and firmness of the fibrous adhesions formed around the end of the dislocated bone, than from the condition of the muscles, which have probably attained their fullest degree of inorganic contraction, and have become partly absorbed at the expiration of two months.

There is, indeed, another obstacle to which I think an unreal importance is attached, viz., that of the residue of the joint becoming filled with a new growth. Nor do I understand how any soft, fibrous substance would prevent the return of the dislocated bone. Its presence might create pain, or might increase the liability to new displacement, but nothing more; and I hardly know how it can be employed as an argument against the attempt being made, for, if successful, why should it not be absorbed? Thus, Dupuytren speaks

of thickening of cartilages, as preventing complete apposition of the bones, when reduced. Of these three obstacles, the second presents the greatest difficulty—that of fibrous growths connecting the bone to the structures around, but especially to the shaft of the bone, on which it rests. But these new growths are far less unyielding in their structure than are the ligaments torn asunder at the time of the original accident, and when we consider the sudden nature of the accident, and the gradual influence of the extending force employed to reduce the dislocation, we can readily conceive that the former was considerably less in degree than the power of extension usually employed in reduction. To effect the complete laceration of these adhesions, the limb should be subjected, under the influence of chloroform, to powerful extension, and should be forcibly rotated in all directions. The pulleys may be employed as if for the purpose of reduction, and with considerable force. This effort should be followed by renewed rotation, under which the adhesions will be felt, and almost heard, to crack asunder. If the patient be exhausted, the attempt at reduction may be postponed till the following day.

The second obstacle, that of the contraction of the muscle, should be met by patient persistence in extension. The extending power should be employed in the most gradual manner, occupying from half an hour to an hour, or longer; the length of time to be determined by the power of endurance of the patient, and to whom chloroform may be repeatedly administered during the progress of the attempt. Should the attempt fail, it may be repeated at the expiration of a week, for a second time; and supposing these two efforts to have been conducted with skill and judgment, and prove equally unsuccessful, any further experiment will probably prove futile. By such means I have succeeded in reducing a dislocation of the humerus, after three months and some days escape from the glenoid cavity.*

The immense experience of Sir Astley Cooper has failed to furnish a single case of serious injury consequent on the attempt to reduce any form of dislocation. He speaks, indeed, of contusions of the muscles, and lacerations of the skin, and insensibility of the arm; but no instance of serious injury is recorded, to awaken fear or distrust in the mind of the operator, or to create an alarm lest the effort should prove seriously detrimental to his patient.

* A report of the above case is given in the "Medical Times," for June, 1848.

In the operation for reducing recent dislocations of the extremities, much of the success depends on the power of endurance of the patient, and this in its degree on the skilful adaptation of the agents of extension and counter-extension. Everything, therefore, depends on the good or ill management of the surgeon. The expression of suffering, which often determines the duration of the attempt, is more frequently directed against the application of the extending force than against that region of the limb on which this force is intended to operate. Patients do not complain of the change in the position of the dislocated bone. Their outcries are especially referable to the opposite end of the bone, or the limb. If great care be bestowed on the application of these agents of extension, much more can be effected, and success will more generally attend the first attempt at reduction.

In the case of large dislocations, such as the humerus, femur, and tibia, everything depends on good management. A well-planned attempt at reduction does not often fail. The anatomical knowledge of the surgeon, relative to the joint, should be perfect; the apparatus complete; the immediate agents of extension and counter-extension deliberately and well applied; the cord sufficiently strong to be beyond suspicion; the staples firm; the material for protecting the skin against injury, whether consisting of wash-leather, caoutchouc, bandage, or linen, ample in quantity.

The counter-extension should be first applied; which, whether over the chest or pelvis, should be so adjusted as not to distort the person of the patient during the extension, or throw it into any irksome position; for it must be recollected that when extension is made, the line between the two extreme points of attachment of the cords, which is composed partly of cord, partly of pulleys, and partly of the person of the patient, will be perfectly straight. The office of the agents of counter-extension is, generally speaking, that of fixing the bone from which we intend to draw, but not invariably so.

The agents of extension should not be applied on the dislocated bone. That for the humerus should be placed around the wrist; that for the femur around the ankle, or at the extremity of each limb. In the case of the arm, from the large size of the biceps muscle, and the uncertain resistance afforded by the elbow-joint, the leather, or whatever other material be employed, is liable to slip over the joint, and negative the whole proceeding; and binding

the elbow to a right angle occasions pain, by throwing the extending force on the forearm. This grievous error would justly attach discredit to the operator. But there remains a yet stronger reason against the application of the extending force to the upper arm; viz., that, by so doing, we are in reality drawing the bone up by the pectoralis major and latissimus dorsi, while, through the medium of the triceps extensor muscle, we are drawing down the identical bone, from which we are making the most strenuous efforts to dislodge the head of the humerus. The same arguments as strictly apply to the other example above adverted to. If the agent of extension, in a case of dislocation of the femur, be applied above the knee, it is liable to slip over the knee-joint; and the same objection holds with regard to the muscles, for we are in this case drawing violently on the rectus muscle, which is attached to the pelvis above. In the one case we are acting on the scapula, and in the other on the pelvis, both of which bones should remain passive, as regards extension.

The patient should be reduced to a state of unconsciousness by the administration of chloroform, which supersedes the old and happily nearly obsolete practice of large venesections, or of prostration from tartar emetic. The operation is otherwise a very painful one, and fully justifies, if any operation can, the resort to this invaluable agent, employed under these circumstances, not merely for the purpose of subduing pain, but for that even more important end, of averting the opposition of the muscles engaged, and, as it were, lulling them into a condition of temporary sleep. It is difficult to calculate what proportion of the extending force is rendered unnecessary by its aid.

The extension should be made slowly, steadily, and uninterruptedly. The necessity for increased tension should be telegraphed by a nod to the assistant in charge of the pulleys. The surgeon in chief should stand at the head of the dislocated bone, one or both hands being applied to the limb continuously, throughout the entire operation, lest the extension be continued after the bone has slipped silently into the socket. Every addition to the tension of the cords should be followed by the cessation of two or three minutes, in order to give the muscles time to relax spontaneously; during which, the surgeon will examine the limb, from time to time, in order to determine whether the bone is descending in the requisite line. Some force of pressure is required for this purpose, owing to the tension of the skin; but still it should be done without giving pain, or unne-

cessarily bruising the surface. In this manner the operation may be continued for a period of from half to three-quarters of an hour or longer, to be determined either by the reduction of the bone, or by the suffering of the patient, supposing the effect of the chloroform to have ceased. The older the dislocation, the more gradual should be the effort, and the longer applied; and I have often felt inclined, in obstinate or protracted cases, to continue a bearable degree of extension, for some hour or two, or even longer, in the hope that the muscles would yield to the unremitting and exhausting effect of continued tension upon them. I have no actual experience resulting from the application of this principle, but it appears reasonable, and may be safely adopted.

The return of the bone into its cavity should be carefully noted by the surgeon. It is characterized by a slight shock given to the limb, which the patient himself is often the first person to note. It is occasionally, in the larger joints, attended by the palpable, and even the audible presence of a dull sound; but it may almost invariably be felt by any attendant whose hand shall happen at the moment to be in contact with the limb.

All the appliances should now be removed, and the patient placed carefully in bed, in such a position as will ensure to the affected joint the most perfect ease. The reparatory agents restore the limb to utility with wonderful celerity, when we consider the extent of the injury that occasionally appears, from the nature of the case, inevitable.

DISLOCATION OF THE LOWER JAW.

The articulation of the lower jaw is composed of the transversely elongated head of the bone, and the glenoid cavity of the temporal bone. Between the shallow socket of the latter and the head, is interposed an interarticular cartilage adapted to both surfaces, and also to that of the eminentia articularis, upon which the condyle can be drawn at will out of the socket by the external pterygoid muscle. The joint has but one, and that an external lateral ligament, although allied in structure to the principle of the ginglymoid joints, which have invariably two. The reason of this arrangement is found in the fact that the lower jaw, though a single bone, moves on two joints, of which the external lateral ligament of one side performs the functions of an internal lateral ligament of the other.

Both behind and on the inner side, the joint is bounded by bone, by which structure simple dislocation is rendered impossible in the inner, outer, or posterior direction. The joint is so unprotected anteriorly, when the mouth is open, by the exposure of the condyle, that the slightest force applied at the moment will suffice to effect a displacement of the bone from the glenoid cavity, and bring it in contact with the posterior edge of the temporal muscle, against which it rests.

The causes of this accident are almost invariably internal, and are rarely the consequence of external violence; although such causes are recorded as occasionally producing it, such as violent efforts at extraction of a tooth. The immediate cause of dislocation of the lower jaw is sudden contraction, allied to spasm of the external pterygoid muscle. When the mouth is thrown open to an unusual degree, from whatever cause, whether in yawning, or laughing, or in the effort to receive into its cavity a larger object than the separation of the teeth can admit without effort, the attachments of this muscle are elongated, in other words, it is stretched, and spasm follows, by which the head of the bone, close to which it is inserted, is drawn suddenly forwards with a degree of violence that carries it beyond the eminentia articularis, and the jaw is dislocated. The displacement may occur on one, or on both sides, but generally on both. Increased liability to this accident occurs in some persons who have a preternatural laxity of the ligaments, and in whom the movements of mastication produce a continued jarring noise, as though at every action of its muscles the interarticular cartilage was dislocated from its position. The muscles of mastication are all preternaturally elongated. The severe pain which attends dislocation of the jaw is attributable, I conceive, rather to the permanent extension exercised on the temporal, masseter, and internal pterygoid muscles, than on pressure of the nerves, as supposed by Boyer; and I am the more readily inclined to doubt this explanation, because the pain is not confined to the situation of the nerves, but extends to aching of the temples, and over the whole of the region to which the muscles are attached.

The symptoms of this form of dislocation are generally, but not invariably, detected without difficulty. I have, on more than one occasion, known them to be established affirmatively only by very careful observation and inquiry.

The mouth is thrown open, or rather the lower jaw is carried

downwards at the symphysis. The obliquity of its base is much greater than when the mouth is opened to its greatest limit in health. The cheeks and angles of the mouth are drawn tight. The orbicularis muscle, that expands the orifice of the mouth in the lateral direction, ceases to act freely; the saliva, the secretion of which is increased by the contact of the air, and by some irritation possibly conveyed to the parotid gland, flows copiously from the mouth. The masseter is tight, hard to the touch, and painful on pressure. The same remarks will apply to the internal pterygoid felt within the mouth. A depression is felt immediately in front of the tragus of the external ear, the situation of which, before the accident, was occupied by the condyle. The articulation of words is rendered exceedingly indistinct. Add to these, the important evidence, that the present condition occurred while the patient was in the perfect possession of the functions of the lower jaw, whether for speech or for mastication; that it followed suddenly an act of yawning, or vociferous laughter, from which moment the jaw was fixed, and the mouth thrown open. These symptoms, usually so palpable on the occurrence of the accident, become, as Sir A. Cooper observes, less distinct in the course of a few days; and probably at the expiration of a year or two, some degree of mobility of the jaw, as well as extension of the cheeks and lips, would return.

The principle of reduction is very simple, the accomplishment by no means so, in the average of cases. It consists of making a lever of the dislocated bone, the force of power being applied to the symphysis at the chin; the fulcrum is formed by the application of the two thumbs, well protected, and pressed on the last molar teeth, or, if absent, on the jaw itself; the weight is placed at the extremity of the bone and is represented by the contractile force of the muscles. This is the principle usually described; but it is greatly deviated from in the act of reduction, for the thumbs, instead of being passive fulcra, become active agents of depression of the bone. To effect this, the patient should be seated on a low stool, or if above the average height, on the ground, and the head supported by a third person. The thumbs should be passed backwards as far as possible, in order to increase their distance from the power, and the chin grasped by the two hands. The jaw should now be forcibly depressed by the thumbs, and at the same moment the chin raised; and the head of the bone will, by this continued effort, pass backwards into the glenoid cavity, care being taken to remove the thumbs from

between the teeth on the instant of its reduction. If, instead of this usual proceeding, we employ two corks, or the handles of two table-knives, or pieces of wood as substitutes for the thumbs, then the principle of the lever is more perfectly effected, in the forcible effort to depress the angle of the bone by raising the symphysis. The former plan is the more simple, and though generally successful, requires considerable manual power in the operator. After the reduction, a bandage should be applied for the purpose of giving support to the jaw for a few days. (See BANDAGES.)

DISLOCATION OF THE STERNAL END OF THE CLAVICLE.

This articulation is not unlike in construction that of the jaw. The clavicle is fixed to the sternum by an anterior, superior, and posterior ligament, and the joint has an interarticular cartilage, with two synovial membranes.

Dislocation is rare; not because the mechanism of the joint is strong, but because the bone itself is weak, the external force being expended on its fracture, not on its dislocation. The cause is referred to violence directed against the shoulder, generally in a fall. It occurs far more frequently forwards than backwards, and for this reason: that in falls forward, the force is expended on the arm, which is instinctively thrown out to break the fall. A severe blow on the shoulder, when drawn backwards on the chest, lacerates the ligaments, and the head of the clavicle is thrown on the sternum.

The symptoms of this injury are indicated by immobility of the shoulder and upper arm; and great disinclination on the part of the patient to move it in any direction; by the approximation of the entire shoulder and arm to the mesial line of the body, as occurs in all injuries to the clavicle, which, as the radius of the upper extremity, affords freedom of movement to it only when entire and in health; by the presence of a considerable tumor at the upper end and side of the sternum; and by the head being drawn downwards for the instinctive purpose of relaxing the sterno-mastoid muscle.

Dislocation backwards is a rare form of accident, of which I have seen but three examples, and all chronic. The cause is a blow on the shoulder when drawn forwards, or, what is more probable, the sudden force of the sterno-mastoid muscle. Richerand mentions the case of a man who met with this accident, while leaning backwards to place a burden on a shelf behind him.

The symptoms are somewhat more difficult of diagnosis than those of the former accident. They consist in the obliquity of the line of the dislocated bone, as compared with its fellow; the indisposition to move the upper arm or shoulder; the absence of the head from its natural position; and the nature of the accident should also be taken into the calculation. I have never witnessed the difficulty of deglutition and respiration described by the old French surgeons as characteristic of this injury, nor can entire confidence be placed in the statements made on this subject.

The principle of reduction is that of elongation of the clavicle, and may be attempted in either of two ways; first, by extending the shoulder backwards; and secondly, by extending it outwards. The first corresponds with the mode adopted to extend the clavicle in fracture of that bone. The patient being seated on a low stool, extension should be made by the two shoulders being drawn forcibly backwards, while the counter-extension is effected by placing the knee against the spine. This mode of extension is generally found sufficient to draw the head of the clavicle backwards into its cavity, when thrown forwards on the edge of the sternum; but a greater effort, and more continuous extension, are requisite for the purpose of dislodging the bone from its situation, in dislocation of the head backwards. If this mode of extension be found insufficient, the patient should be placed in the sitting posture, and the trunk fixed, by means of a broad belt of sheeting drawn round the chest, and extension from the arm should be carried out in a straight line from the body, and drawn a little backwards or forwards, as the direction of the clavicle may determine.

When the bone is reduced, a *large* pad of soft material, such as a pair of worsted stockings rolled up tightly, should be immediately placed in the axilla, and the arm brought to the side. By this means, permanent extension is maintained, and the escape of the bone prevented. The arm should be firmly bound to the body, the shoulder supported, and the clavicle fixed in the direction opposite to that in which it has been thrown by the accident. If dislocated forwards, a firm pad should be bound over the head of the bone.

DISLOCATION OF THE SCAPULA FROM THE ACROMIAL END OF THE CLAVICLE.

This is an arthrodial joint, consisting of the adaptation of two plane surfaces, and fixed together by a superior and inferior ligament.

The single dislocation to which it is usually subject is caused by a blow on the shoulder, by which the acromion process is forced in under the clavicle. The separation of the two bones is slight, owing to the tenacity of the coraco-acromion ligaments, which, being on the stretch, limit the degree of separation. The symptoms, as regard the arm, correspond with those attendant on the last form of dislocation. A small enlargement is apparent on the acromion, which should be carefully compared with the opposite side.

The principle of reduction is also identical with that of dislocation of the sternal end of the bone. The shoulders should be drawn backwards, or the arm outwards, and slight pressure be made on the dislocated bone, which will pass into its position without much effort. To retain it in contact with the articular surface of the acromion, is always a difficulty. This end, however, will be attained by a firm compress on the articulation, full extension of the shoulder by means of a compress placed in the axilla, and elevation of the entire arm, which should be fixed to the side in a sling. A case is related in the sixteenth volume of the British and Foreign Review, of dislocation of the clavicle from the scapula, produced by the kick of a horse. The mode of reduction in this case would be nearly the same as the above—permanent extension by a pad in the axilla, but no elevation of the arm.

DISLOCATION OF THE HUMERUS.

The humerus is more frequently the subject of dislocation than any other bone in the body. This fact is due both to the utility, and to the great mobility of the upper extremity. In reference to the former, we must recollect that the arm is our only agent of defence; that it guards the trunk against danger with an active and vigilant eye; that it protects us against blows, and falls, and violence of almost every kind, while its mobility is such as to carry it in all directions without effort, embracing in its extent of motion

nearly half a sphere. Its peculiar construction, no doubt, contributes its share to the liability; for, though it is classed by common consent among the enarthroses, or ball-and-socket joints, the socket is so shallow as to admit little more than a third part of the nearly spherical head at one time. It is on this shallowness of the cavity that the mobility of the limb depends, to the depth of which, indeed, a slight addition is made by the glenoidal ligament, which encircles it. The articulation is surrounded by a fibrous capsule, attached above to the exterior of the neck of the bone, and connected indefinitely to the shaft, below the cartilaginous surface on the head, where it is intermixed with the tendinous insertions of the muscles, which are here lost upon the bone. These muscles are the supra-spinatus and biceps above, the subscapularis on the inner side, the infra-spinatus, and teres minor, on the outer side, and the triceps below. An expansion of the tendons of the supra and infra-spinatus, teres minor, and subscapularis, tend materially to strengthen the fibrous capsule. The tendon of the biceps passes over the joint, entering a fissure or canal in the capsule, and in the bone below it, and the triceps behind is only in contact with the articulation when the arm is raised. A bony arch exists above the shoulder-joint, formed by the junction of the clavicle with the acromion process of the scapula. From this bony arch arises the deltoid muscle, which in its descent is thrown outward, by the head of the humerus, by which it may be said to be supported; so that, in the normal condition of the joint, the deltoid projects in a rounded form, the fibres of its origin being nearly horizontal. On the inner side of the shoulder-joint, the coracoid process of the scapula may be felt between the deltoid and pectoralis major muscles, and over the joint extends the coraco-acromion ligament. The pectoralis major, arising from the clavicle, sternum, and fifth and sixth ribs, forms the anterior margin of the axilla. The general action of this muscle is that of approximating the arm, when extended, to the side; but inasmuch as a large part of the muscle is placed below the level of the joint, this portion will tend, under some circumstances, to draw the head of the bone downwards. The same remark may be made with respect to the latissimus dorsi, which, connected with the lowest region of the back, will possess a similar power.

I have given the above sketch of the general construction of the shoulder-joint, in order to recall to the reader's recollection the parts

involved in the dislocation of which it is the seat; not with the idea of connecting with its structure the cause of them.

The shoulder-joint is peculiarly liable to injury, not because the head is large and the socket shallow, or the ligaments weak, but rather because it is more exposed to injury than any other joint in the body. Its liabilities exist in a far greater degree from external than from internal causes. There is, perhaps, scarcely a joint in the body that could withstand the violence to which the shoulder-joint is occasionally subjected. It is more correct to say that this articulation is liable *to violence*, than that it is liable to displacement. What is the power of resistance of the human mechanism, in comparison with the mechanical force that may be brought to bear upon it? Ligaments, tendons, muscles, form a very inefficient protection against external force operating upon a joint; and it does appear to me a limited view of this subject, that which deems any given part free from danger, because nature has clothed it in a stronger mantle. The size and strength of the ligaments are suited to the daily wants of each part, and to the force of its muscular contraction; and under the best circumstances, they form but a limited protection against injury from mechanical force.

Sir Astley Cooper, the highest authority who has written on this subject, divides dislocations of the humerus into four; first, downwards, into the cavity of the axilla; second, inwards, on the chest, with the head of the bone lying in contact with the ribs, at the extremity, or on the inner side of the coracoid process, and resting on or under the edge of the pectoralis minor, in the subclavicular fossa; third, backwards, on the dorsum of the scapula; and, fourth, a partial dislocation, in which the head of the bone lies on the lower edge of the glenoid cavity. But this division, however correctly it expresses the situation of the head of the bone, is, for reasons to be afterwards stated, not so valuable, in a practical point of view, as such a division would prove in the case of other joints; first, because it does not infer a distinct difference in the direction of the force causing the injury; and, secondly, that it does not, in any material respect, require a modification of the means resorted to in the attempt at restoration. This will not hold in the case of the hip-joint, for example, in which the position of the head of the bone is determined by the direction of the force dislocating it, and in which the attempt at reduction, that would be applicable in one form of dislocation, would be less so in another. In all these forms

of accident, the fibrous capsule is more or less lacerated, while the extent of injury sustained by the various muscles and tendons surrounding the joint, depends on the suddenness and the violence of the force that has effected it.

When the head of the bone is thrown into the axilla, its most frequent form of displacement, it is probable that the tendon of the biceps escapes from the groove in the bone, by reason of the capsule which retains it being lacerated and loose, while the supra-spinatus muscle is painfully elongated. The upper fibres of the subscapularis will either be partially detached from the bone, or be similarly stretched. When the head of the humerus is thrown inwards on the chest, the same remark will apply to the infra-spinatus and teres minor; and most especially are these two muscles liable to be detached from the bone, or lacerated, in the case of dislocation of the head backwards, in which it would appear almost necessary that the subscapularis also be torn asunder; yet I do not believe that it is so. It is difficult, however, to obtain certain information on these points, from the infrequency of death consequent on recent injury; but, considering the comparative slightness of the pain, when the head of the bone is out of the socket, so long as the arm is at rest, and the rapid progress patients make towards recovery after reduction, it may be doubted whether the injury sustained by the muscles around is so serious as has been generally represented.

In considering the causes of dislocation of the humerus, we should always keep in view this remarkable feature in the construction of the shoulder-joint, that it is formed by the head of the bone revolving in a *movable*, not a fixed, socket; and however justly chargeable the ligaments of the articulation may be with weakness, the fact alone of its great mobility affords it a degree of indirect strength which more than compensates for their weakness; and I conceive that the knowledge of this mobility is essential both to that of the nature of the cause of dislocation and to the principles on which the reduction should be attempted.

The cause of dislocation of the humerus may be generally assigned to a fall. It is quite possible that the head may be displaced from its socket inwards by a violent blow given to the olecranon, if the arm at the instant be thrown backwards; but this cause, for obvious reasons, must be a rare one. At the instant of falling, the arm is thrown out from the body for protection, and should it meet,

in the act of falling, with any obstacle coming in contact with it, before the hand reaches the ground, or should the arm be so extended as to reach the ground at the moment at which the shaft of the bone is placed at a very obtuse angle with the socket, the bone will be forced downwards through the capsule, and become dislocated.

In the act of falling, the arm is mechanically thrown out, without calculating the obstacle it may first come in contact with. If a person be thrown down with violence, while standing sideways at some feet distant from the edge of a chair, and the extended arm be caught in the fall by the edge of the seat, about two-thirds of the way down the forearm, the whole weight of the body, superadded to the force of the impulse, bears upon the capsule of the shoulder-joint and its laceration is inevitable. We have here two forces meeting in the centre by a long and powerful leverage; first, the arm, the remote end of which has a firm fulcrum on the chair; and the second, the body, the impetus of which can have no possible interruption, and the whole force is expended on the capsule of the joint with a weight of many hundred pounds. It is not, therefore, surprising that the capsule yields to the force, and it would probably yield were it double or treble the natural thickness.

This is the cause of the one *primary* dislocation of the humerus, by which the head of the bone is forced from its contact with the glenoid cavity. So long as a person lies in the position in which he fell, the dislocated bone remains in its situation below its socket. The *subsequent* position of the bone, whether in the axilla, under the pectoral muscle, or on the dorsum scapulæ, depends on other circumstances, viz., its relation to the trunk, in the act of being raised; for, as it is very rare that the then elevated position of the arm be retained for a moment, the arm falls, and the fall of the arm, which constitutes some considerable addition to the primary accident, and is no doubt often the continuance of the original violence, inasmuch as a person makes an immediate effort to rise, determines the future position of the head of the bone, and the name applied to the form of dislocation. Thus we speak of dislocation downwards, forwards, or backwards.

It is by this secondary force that injury is sustained by the muscles around, and as that, though considerable, is materially less than the primary force of the fall, it is not surprising that patients so quickly recover the movements of the arm. This is the only divi-

sion of primary and secondary dislocation of the humerus that I am acquainted with; and I quite agree with Mr. Pott and Sir Astley Cooper in their opinion, that a new displacement, caused by a subsequent contraction of the muscles, occurring without a second accident, of which, indeed, one example is recorded, is almost impossible. It does not appear an unreasonable assertion, that there is in reality but one form of primary dislocation, viz., that in which the head of the bone is in the first instance thrown downwards. The most common position for the bone to occupy is that in the axilla, in any part of the line between which, and the extreme position inwards, the head of the bone may rest. There is no definite point at which dislocation into the axilla, as it is called, becomes dislocation inwards under the pectoral muscle. It is a matter of opinion, except when very positive, and so long as there is a variety of authority, there will be variety of opinion.

It does not appear difficult to explain the comparative frequency of the displacement into the axilla, and the infrequency of that on the dorsum scapulæ. The explanation is found in the natural position of the arm with regard to the chest, and the general economy of the body. In a fall forwards, both arms are brought into requisition, and therefore the occurrence of injury is less probable; whereas, a side fall involves one arm only, the other being uselessly placed at the opposite side of the trunk. If this reasoning be correct, no fall but that in an oblique direction forwards, in which possibly the opposite extremity may be paralyzed, or engaged in some very important duty, such as carrying an object of value, could become the cause of that primary form of dislocation, of which the secondary effect would be a displacement backwards on the dorsum scapulæ. A man cannot ve‹y easily sustain a dislocation of the humerus who falls directly backwards; a fall forwards engages the protective effort of both upper extremities, and the facility with which the force of the concussion from behind is modified by the sudden extension of the foot forwards renders dislocation in the posterior direction also very rare; but that of a fall outwards, which paralyzes at the instant the services both of the other arm and the leg of the same side, is necessarily the most frequent cause of primary dislocation, from which, according as the arm meets its resistance when drawn more or less backwards, is the head of the bone thrown into the axilla, under the pectoral muscle, or at any intermediate position between them.

The above principle may prevail, although the attitude of the man's body continue vertical. My friend, Mr. Henry Landor, of Burton-on-Trent, told me of a case of dislocation of each humerus into the axilla, of a butcher in the act of raising a calf, which fell backwards over his head. He reduced both dislocations with his heels in the axillæ.

The *symptoms* of a dislocated humerus, though generally palpable, are not invariably so. Many kinds of accident about the shoulder may raise a suspicion of dislocation, while genuine dislocation is rarely mistaken. Contusions of the deltoid muscle, followed by inability to raise the arm, particularly if occurring in a person of small muscular development; fractures of the head of the bone; severe blows on the acromion, also precluding the action of the deltoid or supra-spinatus; wasting of the deltoid from long disuse, or from disease of that muscle; or paralysis, from injury to the circumflex nerve, may be mistaken by an inexperienced eye for dislocation of the humerus. But a rule prevails in regard to the dislocation of this bone, similar to that which applies, indeed, to all other forms of dislocation, and to all positive disease in every part of the body; viz., that, however liable we may be to mistake the resemblances for the real affection, we rarely mistake reality for the resemblance. Whenever, after some care being bestowed on the case, the question is raised, Is this dislocation, &c., or not? in nine examples out of ten, whether the principle apply to a supposed dislocation, to hernia, or to aneurism, it may be answered in the negative. For the symptoms of most diseases are positive in their nature and unmistakeable, and, in their aggregate, are generally conclusive; whereas in the imitations, the attention is directed to one or two symptoms only, which it has in common with the real disease, and the conclusion is hastily arrived at that the patient has sustained the more serious form of injury.

Of all the characteristic symptoms of dislocations of the humerus, that of flattening of the shoulder is the most striking. The deltoid muscle, having lost the support of the head of the bone, falls vertically to its insertion below. If we press the fingers upon it, although it is in a state of considerable tension, it conveys the sensation of hollowness underneath; and especially so, if the arm be extended during the pressure. Compare this form of the shoulder with the opposite, and the difference between the two

is obvious. The bony origin of the muscle from the acromion is become quite distinct, in consequence of the almost right angle which it now forms with the descending muscle. The humerus, however, is not vertical, although the deltoid is; for the shaft is drawn outwards by the supra-spinatus muscle, and also by the deltoid; and the elbow, therefore, stands from three to six inches from the side, which it cannot be made to approach, without pain. The pain is referred to the region of the joint.

This symptom, however, is not an invariable one, for after some days, or a week or two, or even at the time of the accident, if the mobility of the head be considerable, the condyles at the elbow can be brought inwards to the side without pain or effort. Consequent on the partial extension of the arm, is a leaning position of the trunk towards the affected side, obviously for the purpose of relieving the tension on the head of the bone. If the patient's arm be extended, and the hand be passed upwards into the axilla, and the extended arm be freely rotated with some force, the movements of the head of the bone will be clearly perceived. Compare this with the opposite side. It is difficult to feel the head through the pectoral muscle satisfactorily.

The arm is elongated by about an inch in dislocation in the axilla, but not generally in dislocation inwards; for, in this case, the head is placed on a level with the glenoid cavity. The great importance of accurate observation of this symptom is strongly insisted on by Dupuytren, and also by Mr. Vincent, who both have relied upon it confidently, in the absence of other evidence, and with great success prosecuted the attempt at reduction.

The movements of the arm are limited, and are more or less painful, although occasionally a patient will swing it backwards and forwards, when requested to do so, without complaint. He will also make an occasional attempt to raise it, but rarely or never to draw it to the side. The arm is reported to be discolored by the pressure on the axillary vein in dislocation inwards; but neither from the displacement downwards into the axilla, nor in that backwards, either on the inferior costa, or on the dorsum scapulæ.

An œdematous state of the entire limb is adverted to by Desault and Bell, as an occasional occurrence in dislocation of the humerus inwards. It is also alluded to by other authorities. My experience, however, would not justify my considering it otherwise than as a very rare symptom, although I have at the present time an example

under my care. The head lies very high in the axilla, the bone appears broken, and the arm much swollen from solid œdema; dislocation has existed for eight weeks.

The general aspect of the shoulder should be scrutinized from the front of the patient, at the distance of some six or ten feet, when the irregularity of the line of the bone will be readily detected by the eye. An experienced eye will often detect dislocation of the humerus at a glance. Grating of bone, allied to the sensation of crepitus, is an occasional occurrence. I have known it to exist in four or five cases; in the first and second of which, I felt persuaded that a fracture had taken place. It is possible that the bone may have been splintered.

If, to the above symptoms, we add the evidence of the patient himself—who will certify to the former condition of his health, his fall, and his present state of helplessness—we have abundant and conclusive evidence that the head of the bone is out of the socket, and we shall find little difficulty in determining whether the head be thrown inwards, on to the chest; downwards, into the axilla; or backwards, on to the dorsum scapulæ.

The modes of reduction practised by the modern school of surgery are various. Those of the old surgeons, the principle of which consisted in the employment of the weight of the body as an extending force, when the arm was drawn at length over a door, or a ladder, as also the application of the ambi, of still higher antiquity, are deservedly superseded by measures dictated by a sounder knowledge of the anatomy of the region. The principle now adopted is that of drawing the head of the bone in the direction of the socket, obviating at the same time the action of such muscles as have the power of inclining it in any other than this one direction.

For example, if the arm be extended at right angles to the body, a mode adopted by some surgeons, the pectoralis major and latissimus dorsi would tend to draw the head down from the socket. If the bone be drawn straight downwards, parallel to the body, *after the scapula is fixed*, we should find ourselves contending against the action of the deltoid and supra-spinatus. With a view to meet these two difficulties, it is sometimes recommended that we make extension in a direction between the two lines, or at an angle of about 45°. When the surgeon has made a full examination of the case, and enabled himself to form a tolerably correct opinion of the force required to replace the head of the bone in its socket, he will

determine how far it is necessary to resort to the use of pulleys, or whether his own personal efforts may not prove sufficient. Almost under any circumstances of disparity in size between the two parties, it is desirable, in recent dislocation, to make this latter attempt by the employment of the simplest agents. The patient should be undressed, and placed on a mattress; chloroform should be administered in moderation, and the surgeon, sitting upon the bed on the dislocated side, places his heel (from which, it is hardly necessary to add, the boot should be removed) which is nearest to the patient, as high as possible in his axilla. Taking the patient's hand on the side dislocated, within his own grasp, he leans slowly backwards, gradually making as much extension as he can. In drawing the arm downwards, his heel sinks more deeply into the cavity of the axilla; and unless under peculiar circumstances of difficulty, this method usually succeeds in the course of five minutes. In this operation, the heel is supposed, but I believe erroneously, to act as a fulcrum, the pressure against which forces the head outwards, in the direction of the socket. Sir A. Cooper considers the mode above described to be successful in its application to three-fourths of the cases. A second mode is that of having extension made by an assistant at the wrist. The hands of the surgeon grasp the arm, close to the dislocated end, and he then draws it forcibly upwards towards the glenoid cavity. With an aged or weak subject, this plan is occasionally successful; but for reasons afterwards to be mentioned, it exerts a far less influence on the position of the bone than that of extension made with the heel in the axilla.

Another plan is occasionally adopted, of placing the knee to the axilla, and employing the patient's arm as a lever, which is forcibly drawn downwards across it. This raises the head of the bone towards its socket, which it may occasionally enter; but if the attempt to reduce the bone by means of the heel in the axilla have failed, it is very improbable that either this or the preceding method will succeed.

When the case is obstinate, and we are compelled to resort to the use of pulleys, it is recommended that the scapula be fixed by the mode of application of a round towel, or a strong oval ring of leather, either, to be firmly secured into the wall. The extending agent is then to be fixed on the wrist, and not above the elbow, for reasons given in the introductory chapter. The patient may be placed either in the sitting, or the lying posture, but the latter is preferable. Chloroform being administered, the extension should

be made nearly downwards, or certainly not higher than an angle of 45°, with a view to obviate the actions of the pectoralis major and latissimus dorsi. Those who recommend this plan would generally adopt lateral extension of the humerus upwards, near the axilla, by means of a second towel; but I cannot say that I have seen benefit from its employment. The extending force may be continued for thirty or forty minutes, uninterruptedly. Some authors recommend the arm to be thrown across the chest, thus making a lever of the dislocated bone. Dupuytren, a man of great experience, revived a plan invented by Mr. White of Manchester, which he erroneously ascribes to the invention of a Frenchman, and which the former thus describes: "One assistant grasped the wrist of the affected arm, and raised it to a line parallel with the trunk, making extension directly upwards, whilst another assistant pressed upon the scapula, for the purpose of making counter-extension. I was thus left at liberty to direct the head of the bone with my two thumbs, which I did in a sitting posture."*

Of these numerous modes of reduction, there are but two which I can strongly recommend; viz., the first, with the heel in the axilla, the principle of which is, I conceive, however, greatly misunderstood, as also the source of the success that so frequently attends its employment; and, secondly, that of Mr. White, adopted by Dupuytren. With respect to the plan of placing the heel in the axilla, it should be constantly kept in mind, that the shoulder-joint has this peculiarity in its construction, viz., that it is composed of two bones, each of which is movable on the trunk, and that, in the act of extension, we not only affect the position of the bone we are extending, but, through the agency of the muscles connecting them, we also affect the relations of the bone we are extending *from;* and in the case of the humerus and scapula, that the agents of extension do affect both bones, cannot be doubted. By fixing the scapula, we retain the glenoid cavity in a direction looking straight outwards from the trunk; but if we leave the scapula untouched, then, by the act of drawing down the humerus, we depress at the same time the acromion, by means of the deltoid which is attached to both. The consequence is, that in depressing the acromion we *direct the socket of the bone towards the dislocated head*, and readily get rid of the obstacle, which is often immediately caused by the rim of the glenoid cavity alone, and we bring the two surfaces of bone within the range

* Dupuytren on Injuries and Diseases of Bones. By Le Gros Clerk.

of what I may term their natural affinity, and by the agency of which they immediately coalesce. With the heel in the axilla, we make a simple extension of the arm from the wrist; we leave the scapula unfettered, to assume its own direction; and by the extending force, slightly as it is applied by one person only, *the scapula is made to revolve on its centre, through the leverage exercised on the acromion by the deltoid;* and the pectoralis major and latissimus dorsi, being thus relaxed, exercise no prejudicial influence on the movements of the humerus. I have seen the protracted efforts of pulleys, drawing outwards, fail again and again, with the utmost effort, when the head of the bone has been restored to the glenoid cavity, by the single agency of one person subsequently placing his heel in the axilla.

There is no reason why, in very muscular subjects, or in old dislocations, the same principle may not be applied conjointly with the use of pulleys. For the purpose of retaining this admirable, because most efficient, principle, I employ a well-padded iron knob, which

Fig. 9.

may represent the heel, from which there extend laterally two strong straight branches of the same metal, each ending in a bulb or ring of about four inches in length, the office of which is designed to keep the margins of the axilla as free from pressure as possible; for what operation can be more absurd than the endeavor to fix the scapula by means of girds carried round the shoulder, in which we include the margins of this cavity, viz., the pectoralis major and latissimus dorsi, as in a vice, and by which we endeavor to drag up the arm, *at the same instant that we make the most strenuous efforts to drag it down by a yet superior force?*

It is of the utmost importance, if we wish for success, that we have the margins of the axilla untrammelled, in order that the bone be allowed to descend, unchecked at least by our own agency. The iron knob should be passed high up into the axilla and attached to cords fastened into a staple.

The person of the patient should be placed on the back, or inclined over on to the opposite side, and the cords passed up on each side

Fig. 10.

of the shoulder, one in front and the other behind the joint; the arm should be drawn downwards, as nearly as possible parallel to and in contact with the body. Extension should be made from the wrist, and, especially in old cases, continued gradually. As the humerus descends, the scapula will roll forwards, and the glenoid cavity, instead of staring away from the head of the humerus, will be directed downwards towards it, in the axillary cavity, or equally so when under the pectoral muscle; and although I have never employed the same means in reducing dislocation on to the dorsum scapulæ, I have no doubt of its power to accomplish it.

On the above plan I have succeeded in reducing a great many dislocations, whether occurring in very muscular men, or after some days', or weeks' or even months' duration; and it is, I conceive, especially applicable to such cases of long standing as require long and persistent extension.

The plan of Mr. White, of Manchester, by which the arm is drawn upwards towards the head, has this objection, viz., that it applies considerable force in a very distorted line, and one cannot imagine that it could be effected without injury sustained by the subscapularis muscle; yet Dupuytren speaks of a dislocation reduced in this manner, in which the patient had recovered the free use of the arm *in twelve days.*

Of the numerous methods above alluded to for reducing the dislocated humerus, it is not intended that all, or even many, should be adopted in any one case. The first, and most efficient, should perhaps be first selected, viz., the heel in the axilla. Should this measure fail, it is better to resort to the pulleys at once, as the most certain method of effecting the reduction. I have recently seen a

case of dislocation of the humerus, in a powerful man, reduced within two minutes by being raised over the knee of a house surgeon of not more than ten stone weight. The patient was placed under the influence of chloroform, and the effect was beautiful as it was wonderful. Unhappily, public, and even professional prejudice, yet lives to restrict the full utility of this invaluable agent.

DISLOCATIONS AT THE ELBOW-JOINT.

Dislocations at the elbow-joint exhibit the greatest variety, and also the greatest complication of any joint in the body, in which condition they present difficulties of the most formidable kind to the surgeon, and occasionally, nay often, defy the diagnosis of the most experienced members of our profession. This difficulty is founded on the compound nature of the joint, the existence and the variety of so large a number of projecting processes, each of which is liable to injury, and to the thick investment of muscle, with which nature has covered the front of the articulation.

The humerus terminates below in its two condyles, of which the internal one projects considerably. The ulna embraces its articular surface, by means of a considerable concavity, terminating in front in the coronoid process, which, in extreme flexion of the arm, is received into the anterior depression of the humerus, and behind in the olecranon, which, in extension, falls into the posterior and larger depression of that bone. The head of the radius revolves on the articular surface of the outer condyle, and also in the lesser sigmoid cavity of the ulna. It is distinctly felt in rotation on pressure of the finger, applied a good way back, immediately below the outer condyle. Of these processes, the coronoid, the outer condyle, and the head of the radius are closely invested with muscles, the internal condyle and olecranon are prominent.

The front of the joint is covered by the brachialis anticus, by the tendon of the biceps, and its aponeurotic expansion, lost below in the fascia of the forearm, by the brachial artery and median nerve. The large mass of muscles on the outer side, covering the condyle and the head of the radius, consists of the supinators and extensors, which, for the most part, arise above, from the humerus. That of the flexors takes its origin from the internal condyle only.

As to the causes of dislocation in this region, it would be difficult to follow them in all their variety; no doubt they are generally the

result of falls on the forearm or hand; but the fall and its consequent dislocation are so instantaneous that a patient is rarely competent to give any satisfactory and precise report of its nature, and we can only infer its direction from the form of derangement the structure has sustained. Its frequent complication with fractures of one or more bones greatly increases the difficulty; and this is yet further aggravated by the frequent occurrence of large ecchymoses and other forms of swelling which may entirely conceal the outline of three-fourths of the articulation. Under almost all circumstances, however, two points are visible, viz., the internal condyle and the olecranon. In almost every variety of injury of the joint, these two processes are felt without difficulty, and for this reason, that their relation to the integuments in health is so close that it is very rarely that the cellular connection between them is infiltrated with blood. The relation between these two important landmarks should be distinctly understood, and fixed in the memory of the surgeon, as the knowledge will be found, in cases of complicated injury, always valuable. In the extended position of the arm, the centre of the olecranon is about an inch underneath the condyle, in the vertical direction; and when the arm is bent at a right angle, the olecranon is in a right line with the condyle, and about an inch and a half below it.

Severe injuries of the elbow-joint, whether in the form of fracture, dislocation, or a compound of the two, are frequently followed, at a short interval, by swelling of a formidable kind, in which it is impossible, but by the aid of a perfect intimacy with the anatomical structure of the joint, to detect the relations of one part with another; but even under this difficulty, the two points in question are readily distinguishable. In such forms of swelling, the arm, including the length of six inches both above and below the joint, may be involved in the extravasation, and this swelling may distend the arm to a circumference of one-third beyond its natural size. In such circumstances, in which it is impossible to determine with any certainty whether any, or what bones are broken, or whether or not dislocated, the difficulty of the case should at once be stated to the friends of the patient.

A surgeon is justly responsible to society for the entire restoration of many forms of injury to their condition of health, provided no extreme or unusual difficulty exist in the nature of the accident, or arise in the course of treatment, and in which he is justly

chargeable with the consequences of failure; and the records of law unhappily teem with examples of a compulsory retribution, the award of ignorance or neglect. But in the case now imagined, which sets at naught the knowledge and the foresight of the most experienced, a surgeon can only render himself responsible for the result by the assumption of power which he does not possess, or by volunteering an unguarded pledge of his ability to restore the joint to its former condition of health. This is obviated by a candid avowal of the difficulties of the case, and his willingness to avail himself of the co-operation of others, who can, at least, lighten his burthen by sharing his responsibility.

The penalties of law are justly enforced on those who play a single-handed game, by which they deprive their patient of the advantages to be derived from the experience of others; whereas, they should rely on the well-known adage, which under no circumstances is more pertinent than when applied to a medical man placed in this critical position, that "union is strength."

Authors do not agree in the natural division of dislocations at the elbow-joint; first, because the compound nature of the joint admits so large a variety of injury; and, secondly, because, as the degree and direction of the displacement of a bone depend on the extent and direction of the force causing it, it is probable that no two dislocations of the elbow exactly correspond; and, moreover, we may readily believe, that we have yet to learn all the varieties of injury to which it is liable under the influence of eccentric forces bearing upon it.

Thus each author, taking his own experience for his guide, describes those injuries which he has seen, while it may be not unreasonably supposed, that many varieties, or at least many degrees of displacement, have escaped the observation of men of the largest experience. That of Sir Astley Cooper produces a variety of five different dislocations of the forearm. First, the two bones backwards. Second, the two bones thrown laterally, the radius occupying the articular surface of the ulna, and the latter bone forced off the humerus. Third, the ulna alone thrown backwards. Fourth, the radius forwards; and fifth, the radius backwards.

Of these forms of dislocation, that of both bones backwards is, perhaps, of more frequent occurrence than that of all the other varieties taken together. I have observed it to have occurred most commonly in the persons of children, and almost invariably in con-

7

sequence of a fall. It may be readily detected by the unnatural position of the olecranon, which projects an inch or more higher than when occupying its natural position in the posterior fossa, which is now occupied by the coronoid process. The triceps muscle is forced backwards, resembling, in its appearance, the connection of the tendo-Achillis to the os calcis. The arm is slightly flexed and supinated by the compound action of the biceps, which draws the tubercle of the radius forwards; the skin in front of the joint is in a state of tension; the projection of the humerus is apparent in front—the joint is nearly fixed, and capable only of the slightest motion in either flexion or extension. If the condyles are firmly held by one hand, the dislocated extremities of the radius and ulna can be moved in the lateral direction.

The arm should be carefully compared with that of the opposite side, and, under all circumstances, inquiry should be made as to its condition before the accident. I remember a boy submitting to a painful and protracted attempt to reduce a dislocation of his fore-arm, on the failure of which he got up with a laugh, and said, "I knew you couldn't do it; it's been out these ten years."

The attempt at reduction is recommended to be made by placing the knee in front of the elbow-joint, grasping the wrist with the hand, and drawing it forwards, at the same moment that the fore-arm is forcibly bent round the knee, employed as a fulcrum. By these means the coronoid process is detached from its position in the posterior fossa, and is drawn round to the front of the articular surface of the humerus. It is very probable that the annular ligament, connecting the radius to the lesser sigmoid cavity in the ulna, is unbroken, and the two bones will return together. Although this mode of reduction has the high sanction and the recommendation of Sir Astley Cooper, I confess I entertain the strongest objection to it; not only because I have rarely known it to succeed, except by a long-continued effort of flexion, to which additional extending power was resorted to, but because it appears to me opposed to the first principles which ought to direct our conduct in the attempt to restore a bone into its cavity.

My objections are founded on the following grounds: that children are more frequently the subjects of this dislocation than adults; and that in children the coronoid process is not firmly attached to the shaft of the ulna, but is yet an epiphysis, and continues such till fourteen or fifteen years of age; that in the attempt to bend the arm,

the ulna is employed as a lever of the first kind, of which the posterior part of the articular surface of the humerus is the fulcrum, the weight being represented by the triceps, attached to the olecranon; that the force employed, which with such leverage is very great, may seriously damage the coronoid process, if not fracture it—and I am satisfied that I have seen this done; that the immediate obstacle to the return of the bones is seated in the coronoid process, which causes the projection of the ulna backwards; and that by bending the arm, before full extension is made, we force this process against the bone, instead of endeavoring to detach it from the surface that appears to hold it.

I have endeavored, in the introductory part of the chapter, to enforce the importance of the principle, that the general extension of the muscles in the axis of the affected bone ought to be adopted, for the purpose of bringing a bone downwards, within the range of their general, and not their individual action; and that we gain nothing by the resort to any direct line of traction, by which we give relief to one or more muscles at the expense of others; and I conceive that this form of dislocation affords abundant evidence in support of this principle, both in theory and in practice. If we examine the construction of the joint on the skeleton, it appears obvious that simple extension will accomplish everything; that it presents the readiest mode of detaching the coronoid process from the posterior fossa, or from the posterior surface of the humerus, supposing it to be forced beyond the fossa into extreme retraction; that it employs equal and fair tension both on the biceps and brachialis anticus in front, and on the triceps behind; that all that is required for success is to bring the coronoid process below the trochlea or pulley of the humerus—for the radius presents little or no obstacle—when it will rush forward to its natural surface, and the dislocation is reduced.

Unless the patient be a very powerful man, the reduction of the forearm on this principle may be effected by two or three persons, one of whom would fix the upper arm, or simply retain the person of the patient in position. Extension of the forearm should be made from the hand or wrist, *in a straight direction* downwards, as if for the purpose of simply elongating the arm. This extension should be continued with moderate force for some three or four minutes, when the bones will slip forwards, without great effort or difficulty. A strong boy, of about sixteen, was brought into St. Bartholomew's Hospital with this form of dislocation, during the visit of the

surgeon. The case was given into the charge of the house surgeon, who was requested to reduce the dislocation, which he attempted for ten minutes without success. The surgeon himself made a similar effort, by endeavoring to draw the bones of the forearm round his knee, placed over the front of the elbow-joint; but he was equally unsuccessful. The case was then referred to me; and I suggested the act of simple extension, which being adopted, the bones returned to their position, comparatively with the greatest ease.

The observation of the abnormal position of the bones, and that of the compound action of the muscles about the joint, while they would appear to point to the application of the simple principle of extension as the best and most innocuous means of replacing the dislocated bones, receive additional confirmation from its practical application. It is very rarely that any difficulty attends this mode of reduction, which I have both taught and adopted, for many years. Dupuytren reduced in this manner a dislocation of the bones of the forearm backwards, of eighteen days' existence, without difficulty, and Sir A. Cooper acknowledges that in one case he resorted to it with success, when the other plan had failed.

Should the ulna return to its false position shortly after the reduction, and without the occurrence of fresh violence, it is probable that the coronoid process is broken off, and the case then becomes one of some difficulty. The simple fact of the displacement of the bone without violence goes far to prove the separation of this process. But crepitus may be occasionally felt, in the extreme flexion of the arm, and if we add to these symptoms that of peculiar facility of reduction, we shall hardly be mistaken.

The next frequent dislocation at the elbow-joint consists in the displacement of both bones in the lateral direction. They may be thrown outwards or inwards. They are, perhaps, more frequently thrown outwards, the olecranon resting on the back of the outer condyle, the radius off, or nearly off, the bone. The internal condyle projects greatly under the skin, and the olecranon is nearly two inches distant from it. The triceps muscle, retaining its connection with the humerus, passes somewhat suddenly across the olecranon. The arm is nearly straight, but is fixed as regards the power of flexion, and pronation is effected with pain. All these symptoms may be marked by swelling, following the accident within an hour.

In dislocation of both bones inwards, the olecranon is brought

directly behind the inner condyle, and projects backwards, in consequence of being deprived of its fossa. Some of the fibres of the anconeus must be torn asunder. The head of the radius may be felt, in rotating the forearm. The arm is fixed nearly in a straight position. By comparing the two extremities, the abnormal position of the bones will be rendered obvious.

Dislocation of the radius forwards, in my observation, comes next in frequency, although, I dare say, with much reason deemed a rare form of injury by some authors. It is marked by slight flexion of the forearm, and by the presence of an osseous swelling in front of the external condyle, due to the head of the radius, which has broken through the restraint of the annular ligament, and escaped from its contiguity with the ulna. Rotation of the forearm may be performed without much pain, but neither flexion nor extension beyond the point at which the arm is fixed.

Other varieties are spoken of; and any variety or form may occur, of dislocation of these two bones. The radius is occasionally, but rarely, thrown backwards singly, or forwards in combination with displacement of the ulna backwards; and that form of dislocation in which both bones are forced forwards is a recognized, though a very rare accident, which has escaped the observation of many experienced men. It is accompanied with fracture of the olecranon. In truth, if we test the liabilities of the elbow-joint to injury, by the records of surgery, they are numerous indeed; for, as I have above observed, no two authors agree in the number or order of liability, though all acknowledge the great frequency of the dislocation of both bones backward. The difficulty of making any complete classification of these injuries, after having pointed out three or four of the more prominent of them, is little important, if we resort to a general principle of reduction as applicable to all, or nearly all, and that is the principle previously enforced, of extension. Manipulation can effect but little, while extension well applied, with such modifications as particular dislocations demand, will be found a successful means of effecting the reduction of them all. For example, in lateral displacement of both bones, the extending force employed should be moderate, and some lateral pressure by the hand on the dislocated bones will facilitate the reduction. In dislocation of the radius forwards, pressure of the thumbs on the head of the bone may be superadded to extension of the hand. It is unnecessary to say that the extending agent should here, for obvious reasons, be applied,

not to the forearm, but to the hand. With these and similar modifications, I believe simple extension will prove by far the most efficient agent in the reduction of all dislocations at the elbow-joint.

It may be laid down as a general rule that the position that is most comfortable, is the best; but regard should be paid to the liability to a repetition of the injury by the action of the muscles. If the coronoid process be entire when replaced, there is no probability that it will, without renewed violence, escape from its articular aptation with the humerus. The muscles themselves cannot effect this new displacement, for they antagonize each other's action. But if the coronoid process be broken off, then its separation is not only possible, but highly probable, and great care is required in the endeavor to prevent it. Instead of consulting the comfort of the patient, by placing the arm in a slightly bent position, the arm should be maintained in the position at which the elbow-joint is bent, at something less than a right angle. In this position it should remain till some attempt at union of the coronoid process be made; when slight extension may be commenced; not that I participate in the fears entertained by many that anchylosis of the joint is a very probable occurrence, either in this case or in any other similar example of simple fracture extending into a joint. The arm should be bent so far as to insure the two surfaces of the bone being fairly brought into contact. Permanent pressure should be made on the olecranon, with a view to meet the tendency of the ulna to fall back on to the posterior surface of the humerus. This is best effected by a splint fixed along the back of the upper arm, and attached to a gutta percha sling, placed at right angles to it, or by means of two splints connected behind the elbow by a graduated hinge. As a precautionary measure, it is better to apply in all cases a light pasteboard splint, and to roll the arm lightly, unless where much swelling has followed the accident.

In fracture of the olecranon, attendant on the rare dislocation of the ulna forwards, the arm should be placed straight, as the only position that will insure complete apposition of the broken bone. There need be little fear of anchylosis. With regard to the period at which motion may be allowed, it should depend rather on the sensations of the patient than be the subject of any fixed rule. In ten days or more, a slight movement may be attempted, and if unattended with pain, it may be increased daily.

In those formidable cases of injury to the elbow-joint attended by extensive swelling, crepitus from fracture of one or more bones, com-

bined with probable dislocation, and in which, by reason of the swelling, it is impossible to determine the nature or extent of the injury, it is still very desirable to make an attempt at restoration of the bones to their natural position. For this purpose, slow extension should be made as before, in the axis of the limb, and the surgeon should place his hands around the joint, and carefully employ pressure in various directions, moulding it as nearly as can be done to its natural form. The joint should be slightly twisted, and drawn laterally in various directions, till we receive the impression that we are reducing the joint into something like its natural form.

Great relief will be given to the patient by this process. Indeed, the greater the extent of injury, the greater benefit will be obtained; for, although anchylosis will be the probable issue of the case, there is yet no sufficient ground on which to raise the question of amputation, even though a portion of the joint be exposed by the compound nature of the dislocation. I allude to those occasional examples of injury which consist of a general crush of the joint, the result of a fall from a scaffold, or of any great weight falling upon it.

A gentleman, of fifty years of age, of stout build, was thrown a severe fall, out of his gig, and the weight of his entire body fell on his right elbow, over which he rolled heavily. I saw him within half an hour; the arm was enormously swollen from extravasation. The joint appeared crushed, and broken in all directions. He was suffering intense pain. The limb was extended steadily but gently for ten minutes, during which I endeavored to remould the joint by manipulation, pressing forwards, backwards, and transversely, drawing the joint slightly in this direction, then in the opposite. By this continued operation I succeeded in replacing various portions of displaced bone, and of removing a great deal of his suffering. The arm was placed on a pillow a little bent, and he recovered, with slight motion of the joint. In this case I believe the head of the radius, the external condyle, and the olecranon were all broken.

A man was brought into St. Bartholomew's Hospital in the summer of the year 1835, while I was on duty for Mr. Earle, with a compound dislocation of both radius and ulna, at the elbow-joint. The arm had been almost doubled outwards, so as to expose nearly the whole of the articular cavity of the joint, and the soft parts were also a good deal damaged. The injury appeared so formidable, that I advised the immediate removal of the limb. The man strenuously refused his consent, and I had no alternative but

to replace the arm and bind it up. In six weeks he recovered, and the movements of his arm, at the expiration of six months, were comparatively little impaired.

I may allude in this place to a similar case of recovery from injury to the knee-joint. A man was brought into the hospital with compound fracture of the internal condyle, and compound dislocation of the patella, by which the articular cavity of the knee-joint was greatly exposed. The parts were replaced, and the limb rolled. The man was in the hospital for many months, and eventually recovered a considerable extent of motion of the knee-joint.

DISLOCATIONS OF THE RADIUS AND HAND FROM THE ULNA.

Violence applied on the hand may separate the lower end of the ulna from the fossa in the radius, and from its connection with the cuneiform bone, by rupture of the lateral ligament that binds it to this bone. A portion of the interosseous ligament will also probably be torn asunder. It is difficult to imagine how this accident could occur from violence applied on the ulna itself, yet it is not impossible. The relation of the dislocated radius and hand to the extremity of the ulna depends on the nature and the direction of the force causing the injury; but the ulna more frequently projects backwards than forwards, presenting a considerable swelling in this direction; the forearm is prone, and the attempt to supinate difficult to the surgeon, and painful to the patient.

Reduction is effected by extension of the hand, combined with supination. At the same time, the extremity of the ulna should be pressed forwards into the fossa of the radius. Care should be taken, by the early application of a splint, to prevent the recurrence of the accident. The radius and hand may be thrown backwards; while the line of the ulna is felt descending obliquely downwards, in front of the radius, on the end of which it rests, forming a projection in front. To effect its reduction, the forearm should be fixed, a bandage applied around the wrist, and the hand drawn outwards. At the same time, the end of the ulna should be pushed backwards with some force, when extension is fully made, but not before.

DISLOCATION OF THE CARPUS AND HAND FROM THE RADIUS AND ULNA.

This is commonly denominated dislocation of the wrist, and results, like the former injury, from violent force applied on the hand. The most frequent dislocation is that in which the carpus is thrown backwards. The force is generally applied to the extended palm. This, at least, is the cause to which it is commonly assigned; but I am not by any means clear that a fall on the back of the hand, when forced into extreme flexion, may not equally effect it. One reason points, however, to it as the more general effect of a fall on the palmar surface of the hand; viz., that the usual dislocation at the wrist is that in which the first row of carpal bones is thrown backwards on the radius and ulna; and generally, also, the hand would be instinctively thrown open to receive the force of the fall; therefore, we may reasonably attribute the more frequent effect to the more ordinary cause. The carpus may be dislocated forwards on the palmar surface of the bones of the forearm; but this and other possible forms are exceedingly rare.

That the dislocation backwards is an occasional occurrence, I am quite satisfied, having witnessed several examples of this injury, of the most unequivocal kind, which could not be mistaken for fracture of any bone; and yet this form of accident is denied by the great authority of Dupuytren, who asserts that fracture of the lower end of the radius is mistaken for dislocation. He says, and I quote his exact words: "*In spite of all that has been said on this subject, I have never met with, nor heard of, one single well authenticated case of the dislocation in question.*"* He proceeds in a strain of very questionable reasoning to argue the impossibility of dislocation either forwards or backwards, by virtue of the close proximity of the flexor tendons in front—assigning to the extensor tendons the like power of prevention behind! That fracture of the lower end of the radius may have been frequently mistaken for dislocation is not unlikely; but the supposition that the error is an invariable one equals in value that which attributes the supposed variety of dislocation of the carpus to the tendons, and not to the ligaments.

The first objection to be made to this argument is that it infers the invariable condition of contraction of the muscles engaged; the

* Dupuytren on Diseases and Injuries of Bones. By Le Gros Clerk.

second is, that, however tense the muscles in action, lateral pressure of the bones, having already ruptured their ligaments, would suffice to force the tendons out of their straight line, consequent on the enormous double leverage it would act with, by extending from the point under pressure, along the whole line of the muscles and their tendons, up to their attachments.

The symptoms of dislocation of the carpus backwards consist in a swelling in front, caused by the bones of the forearm, and a line

Fig. 11.

of prominence behind, from the presence of the scaphoid, lunar, and cuneiform bones. The arm is shortened, thrown into a state of supination, and is immovable as regards flexion and rotation.

The mode of reduction consists in simple extension of the hand, accompanied by a slight lateral movement, if required by the failure of the extending force.

Dislocation of the carpus forwards is a still more rare accident;

Fig. 12.

the symptoms are sufficiently obvious, and the principle of reduction the same as in the last form of injury. Double paste-board splints; in fact, the treatment of fractured forearm is required for future recovery.

DISLOCATION OF THE THUMB AT THE CARPAL JOINT.

The thumb is occasionally dislocated at the articulation of the metacarpal bone with the trapezium. Though generally the subject of dislocation backwards, examples of displacement forwards occur.

The reason why this dislocation so generally occurs in the posterior direction is, because force is so almost invariably applied in front, whether in a fall, or in the attempt to catch a heavy body, meeting in its descent with unequal force one or other finger; for the same remark will apply to dislocation of the phalanges, which are most generally forced backwards out of their position. In this situation they are firmly fixed, partly by the tendons, and partly by the lateral ligaments which are unbroken, and partly, possibly, by the integuments.

If the dislocation occur at the articulation of the first phalanx with its metacarpal bone, we can apply an extending force to the finger without difficulty, either by the hand, in grasping the finger and drawing in the axis of the limb; by bending the finger in flexion and pressing the bone forwards at the same time; or by forcing it backwards when extended, bringing the two articular surfaces as much as possible in contact, and then making a lever of the first phalanx in order to force it forwards.

A good method of adopting an extending force to the finger is by means of recently made adhesive plaster, well and thickly applied to the entire finger in many layers, including between the folds several longitudinal pieces of half an inch in breadth, till sufficient substance is obtained to insure strength.

The difficulty of applying the extending power increases in each phalanx as we approach the last. Of the last phalanges, that of the thumb is most frequently dislocated; and for reasons before given it is more generally thrown backwards than forwards, where it lies in a state of semiflexion, held firmly by its lateral ligaments. A circle of good plaster, of several layers, should be applied on the last half of the phalanx, and a clove hitch knot of *thick* twine placed below it, and the joint protected by lint. The office of the plaster is merely that of preventing the escape of the cord. Extension may first be made in the longitudinal direction, playing the bone backwards and forwards at the same time. Should this method fail, the phalanx should be bent forwards on the distal extremity of the second phalanx, at a right angle, then drawn forwards till the articular surfaces are in contact. The bone should then be raised upright on to the second phalanx, with some force. Mr. Savory, of St. Bartholomew's Hospital, tells me that he has reduced two dislocations of this phalanx by pressure on the articular surface of the bone, by the two thumbs from behind, with little difficulty.

Mr. Wormald draws the hand over the patient's shoulder, by which means he considers that he obtains a more complete relaxation of the muscles of the dislocated phalanx.

If these measures fail, whether in the dislocation of the last or the second joint, the lateral ligament should be divided by a fine-pointed knife introduced for that purpose under the skin, which will at once remove the difficulty. The serious consequences that attend on wounds of the larger joints do not apply to those of the lesser articulations, such as are now alluded to; and the probability is that no evil would result from this division; but should inflammation follow, and even extend to the absorption of the articular cartilage, and consequent destruction of the joint, the evil would be less to its possessor than that of leaving the phalanx unreduced for life. Time is a great object in these small dislocations. If taken shortly after the accident, they are reduced with comparative facility; but the difficulty, with every day and almost with every hour, increases considerably, and after the expiration of one or more weeks, it is often impossible to effect the restoration of the displaced bone, without division of one of the lateral ligaments. Severe inflammation not infrequently follows the reduction, where much violence has been used.

DISLOCATION OF THE FEMUR.

The hip-joint is the most perfect example of a ball and socket in the human body. The spherical head of the femur is received almost entirely within the acetabulum, from which the neck of the femur, in length about one inch and a quarter in front in the adult bone, and one inch and three-quarters behind, extends downwards at an angle of nearly one hundred and thirty-five degrees with the shaft of the bone below. The shaft is continued upwards beyond the origin of the neck into the trochanter major, which is slightly curved inwards, forming a convexity towards the skin. The trochanter reaches to a level of within half an inch of the upper surface of the head of the bone, and is a little higher posteriorly, towards the sacrum, than in front. From the centre of the head to the centre of the trochanter, is two inches and a-half. From the centre of the anterior superior spine of the ilium to the middle of the trochanter major, in the normal condition of the joint while at rest, is four inches and a-half. The trochanter should project beyond the ante-

rior superior spine in a transverse direction to the extent of about one inch and three-quarters. The centre of the obturator foramen is two inches from the centre of the head of the bone. If the head were forced in this direction but a little obliquely upwards, it would lie on the body of the os pubis, and an inch lower on the descending ramus. The distance from the centre of the bone, when in its socket, to the tuberosity of the ilium, is three inches and a-half. That from the posterior margin of the acetabulum to the edge of the ischiatic notch is one inch and a-half.

The articulation comprises a strong fibrous capsule, arising from the periosteum around the acetabulum, of considerable thickness on the upper and outer side, which is lost generally on the intertrochantral lines below. The ligamentum teres connects the head to the margins of the notch in the acetabulum. Its office is to control extreme abduction of the limb. The joint is invested on all sides very closely with muscles. The rectus, and psoas and iliacus descend in front, the two latter muscles passing down to the trochanter minor; by the gluteus minimus on the outer side, by the pectinalis on the inner side, and posteriorly by the obturator internus, gemelli, tendon of the obturator externus, and quadratus muscles. Between the head of the bone, when felt in the groin, and the skin, we have the femoral fascia, viz., the superficial fascia, consisting more or less of fat, and the fascia lata, the rectus and psoas muscles, and the fibrous capsule. The femoral artery lies on its inner side, but still upon the psoas muscle, and the vein yet more internally, on the pectineus.

The head of the femur is said to be the subject of four dislocations, which I give in the order of frequency, noted in the circle of my own observation; but there are differences of opinion on this subject: first, that upwards on the dorsum ilii; second, that backwards on the ischiatic notch; third, that on the obturator foramen; and, fourth, that on the os pubis.

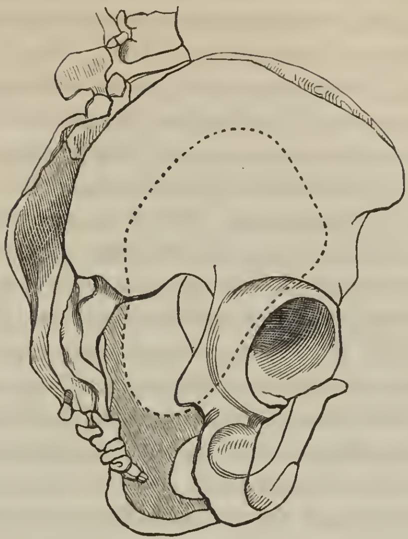
Practically, I am persuaded that this division admits of large modifications, for we rarely find two cases of dislocated femur presenting exactly the same characters. To what cause can the differences in opinion on the position of the head of the bone, among men experienced in these accidents, be attributed, but to the varieties in its situation, and in that of the surrounding structures? It is very rarely that a dislocation of the femur bears out fairly all the written descriptions of authors. Not that these reports have been highly drawn or untruly recorded, but that cases vary in signs and mani-

festations, and hence the inapplicability of those rules which would restrict the liability to injury within certain anatomical limits. I remember, on one occasion, Mr. Abernethy, in his lecture on the hip-joint, laying it down as a rule, that dislocation of the femur, on the dorsum ilii, in which the head of the bone is thrown *forwards*, could not take place. On the following day a boy was brought into the hospital, with dislocation on the dorsum ilii, and in which the head was *thrown distinctly forwards.* The boy had got up behind a hackney coach, and in descending had thrust his leg between the spokes of the hind wheel, by which he had been carried round in one complete circle. The distance to which the head of the bone is carried away from the acetabulum in a dislocation, depends on the violence of the force applied, and hence the modifications I allude to. Such cases as dislocations of the femur should be reported individually; their peculiarities will scarcely obtain the justice due to their importance, by aggregation.

By the above division we exclude altogether by name a variety of dislocation of the femur, which is really of no infrequent occurrence, viz., dislocation on the dorsum acetabuli, and which is nowhere alluded to by authors; also, the fact is not stated, that the head of the bone may occupy the neutral ground *between* the surfaces of the acetabulum and ilium. In truth, observation has taught me that external force may displace the head of the femur in all directions, and in all degrees of distance from its socket; and that no man, who is not familiar with the osteology of this region, can tell its exact position. Practically, I do not assert this knowledge to be so important as it may appear, for we do not necessarily qualify our remedial agents by the existence of these modifications, and yet we are hardly justified in recording the position of a bone which is in fact untrue.

I have seen repeated examples of the following varieties—upwards, on the dorsum ilii, varying in distance from the socket from one to three inches; backwards, in the ischiatic notch, on a level with the socket, and an inch above its centre; on the dorsum acetabuli, both backwards, and upwards and backwards; inwards and slightly downwards over the obturator foramen; yet further inwards on the ramus of the os pubis; inwards, and slightly upwards on the body of the os pubis, below the spine and transverse part of the bone; and straight upwards, nearly in front of the articulation.

Fig. 13.



Many of these are, doubtless, mere modifications of the division propounded by Sir Astley Cooper, and for all practical purposes that division may still prevail; yet it is obvious, by the most cursory glance at the bones, that the relation of the two extremities to each other, the degree of inversion, and the extent of retraction of the limb, must vary according to the position of the bone, and qualify, in no slight degree, the generally adopted opinions of the profession of the nature of the injury. Sir A. Cooper lays it down as a rule, that in dislocation of the head of the femur on the dorsum ilii, the foot of the dislocated side is thrown on the opposite instep. Now, if, on examining a case, a surgeon of limited experience finds this relation of the extremities absent, if he be told to expect inversion of the limb to a certain extent, and there is little or no inversion, he may, not unreasonably, conclude that he has mistaken its entire nature. The fault would then justly attach to the writer, and not to the surgeon.

The cause of dislocation of the femur is violence applied to the thigh or leg, generally by a severe fall, either from a height, or by any additional force given to the natural force of gravity. The general position of the bone, whether outwards or inwards, is determined, we may suppose, by that of the leg at the moment of falling. If the leg meet the ground, or whatever firm object it comes first

into contact with, while in a state of adduction, beyond the central line of the body, the outer part of the capsule is rent, and the head is driven upwards, or backwards, or both. This blow must strike the leg obliquely, for if it meet the limb in a straight direction, the force would be expended on the bone, instead of on the capsule of the joint. If, however, in the act of falling, the leg be abducted, the inner side of the capsule will be torn, and the head thrown inwards, or upwards and inwards. This is the most important division of dislocations of the femur, viz., into that outwards and inwards, the modifications of which into upwards and downwards depend, probably, on the angle formed by the femur with the trunk at the moment of the fall. If a blow strike the outer side of the knee when drawn forwards on the pelvis in flexion, the bone would be thrown backwards on to the dorsum acetabuli, or ischiatic notch; if applied, however, when the thigh is in a state of extension, the head will be thrown upwards on the dorsum ilii. Now as there is no explainable reason why the femur, in the act of falling, may not meet the obstacle at any intermediate angle with the body between flexion and extension; so it follows that the head may lie at any intermediate point between the highest relation to the dorsum ilii, and the lowest, to the ischiatic notch; and *it does lie in all.*

The same argument will apply in the opposite direction, as the cause of dislocation inwards, either on the obturator foramen, or on the descending ramus or body of the os pubis. From the very nature of the accident, therefore, dislocation outwards must be a more frequent occurrence than that inwards.

Supposing the head of the femur to be dislocated ON THE DORSUM ILII, the case will present the following symptoms. The limb is shortened or retracted, to the extent of from one to two inches, by reason of the head being thrown higher than the socket; but the position of the head of the bone cannot be estimated by the shortening of the limb, which is contracted in length for the sake of ease, and is slightly bent at the knee. The limb is inverted in consequence of the head being thrown backwards. The degree of inversion cannot be learnt by examination of the skeleton. On the living body, the head and trochanter both rest on the gluteus medius and on the doubled up gluteus minimus, in what exact manner it is impossible to give any general description that shall be applicable to all cases; the trochanter lies within about two inches of the anterior superior spine of the ilium. The inversion, however, is

not very great, nor is it easy to explain why it is not greater when the head of the femur is fairly carried up on to the dorsum ilii, except by rcference to the muscles. The absence of the head from the acetabulum may be felt on firm pressure. The head and the trochanter are both very perceptible above the situation of the joint, and both may be made to revolve under the hand, by rotating the limb. The limb is fixed nearly in the longitudinal direction, and neither admits of flexion nor extension, abduction nor adduction, without pain. Occasionally, but very rarely, an attempt to walk may be made. I recollect a case of dislocation on the ilium, in which a man walked a quarter of a mile to the hospital.

In dislocation into the lowest part of the ISCHIATIC NOTCH, the limb is not shortened at all, but it is placed more obliquely with regard to the trunk, and in consequence of the head of the bone finding a socket in that cavity the inversion is inconsiderable; the acetabulum is hollow on pressure, the head is felt, though not so distinctly as in the former dislocation; the trochanter is prominent, and a little more freedom of movement is retained to the limb.

The diagnosis of dislocation of the head on any point between these two extremes will be obtained by observing the degree of retraction and of inversion, by calculating the relation of the head to the socket, whether directly above, obliquely, or behind it, and by observing whether the head sinks deeply or not, and whether or not it is on the same level surface with the trochanter; for, if thrown *slightly* backwards, it has not reached the ischiatic notch, but lies on the dorsum acetabuli. In all these modifications, inversion is a general symptom, in some degree or other, and the higher the head be thrown, the more positive will this symptom appear.

In dislocation of the head on the OBTURATOR FORAMEN or os pubis, the bone approaches the mesial line of the body. The different positions the head here occupies are merely modifications of the two varieties of dislocation on the obturator foramen, and on the adjacent bone, for it may fall either on the middle of the foramen, or the descending ramus, or on the body or transverse ramus of the os pubis.

When on the lower part of the obturator foramen, the limb is very slightly lengthened; but the measurement is rendered difficult by the relation of the thigh to the trunk, which is in a state of semi-flexion. This results from the nccessary relief afforded to the tension of the psoas and iliacus, the action of which relates, not to

the thigh, over the movements of which *they exercise little influence at any time*, but to the trunk, which is drawn forwards. Examined in the horizontal position, while in bed, the rectus is called into action to effect the same end, by raising the thigh, and bending it on the pelvis, for the purpose of relieving the psoas and iliacus, now put on the stretch by the trochanter minor being carried downwards. In proportion as this symptom is well marked, the head of the bone may be supposed to lie low in the obturator region. As a general rule, the limb is everted; but the degree of eversion varies considerably, and cannot be relied on with any certainty as a necessary indication of the form of injury under consideration.

In dislocation upon the *obturator foramen*, the most striking external feature is the bent position of the trunk forwards, the toe consequently pointing to the ground; and flattening of the hip, from the inward position of the trochanter major, generally with more or less of eversion of the limb. Examined by manipulation, the limb will be found lengthened, but to an extent dependent on causes above described, and accompanied with some slight power of being rotated inwards, and pain on attempting adduction. The head of the bone may be felt by close examination along the ramus of the ischium and pubes, but its distinctness will be in proportion as it is thrown more or less inwards. Add to these signs, the negative evidence derived from the fact of sudden violence, followed by loss of mobility, and the absence of the symptoms of dislocation of the bone on the dorsum ilii, or ischiatic foramen.

In dislocation upon THE OS PUBIS, we find the same flattening of the trochanter, accompanied with more eversion of the leg. The projection of the head, on manipulating the region of the joint, will depend on its position. If low down on the body and ramus, it will be felt from the perineum, on firm pressure made on the gracilis and adductor brevis muscles; if high on the body of the bone, lying in contact with the highest part of the origin of the adductor brevis, it will be distinctly seen above; if on the horizontal part of the os pubis, and placed more outwards, towards, or even underneath, the vessels, it will be still more palpable on pressure, and the vessels may be felt passing over a rounded tumor; and if still higher, when thrown above the bone, and in contact with Poupart's ligament, its position is very obvious both to sight and

touch. In the latter case the eversion is great, the bone fixed, and the shortening equally positive.

Fracture of the neck of the thigh-bone is readily distinguished from any of the above forms of injury, by great eversion, joined to great mobility of the limb, by crepitus on extension; generally by the more advanced age of the patient, is often marked by ecchymosis about the joint, and by the consciousness on the part of the patient of having sustained a serious injury. In dislocations, a person will generally rise from the ground, and make an effort to walk; in fracture, rarely, or never. With a clear idea of the exact nature of the accident, of which every feature has been carefully and repeatedly studied, the surgeon proceeds to the application of the reduction of the limb.

For this purpose he will require a narrow couch or bed, strong staples for the opposite walls, or doorposts, a round towel in good condition, wash-leather, a sufficient quantity of good rope, and pulleys.

As the patient, while at rest, is suffering comparatively little inconvenience, the desirableness of an early attempt at reduction is no excuse for proceeding to the operation without having at hand all the requisite appliances for effecting it, or for doing that *well* that may be done *better;* and I cannot give more useful advice to any surgeon, not fully experienced in these difficulties, than that of urging him not to throw a chance away, as it is called, but to calculate his difficulties, and to make full provision against them; not to imagine the task an easy one, but to enter upon it with the conviction that all the resources of his art and all his experience may be called into requisition. There is no objection to a superfluity of means, but every objection to an attempt, hastily and inadequately made, which may terminate in failure, either on the ground of want of power or from its imperfect disposition. The deliberate application of abundant resources is indispensable to success, wherever the dislocation of a large bone is under treatment. If the surgeon, therefore, would avoid discredit and self-reproach, let him adopt the best expedients at first, and not apply to their aid only when driven to them by the failure of secondary and inefficient power.

The patient should be laid, if possible, on a mattress, and placed on a low bedstead, and should be fully undressed to his shirt. Counter-extension, by means of a round towel, should be applied up the perineum. The towel should be brought round the ilium

of the affected side, and its edges strongly sewed together, so as to spread over the ilium and abdomen, nearly as low as the trochanter. The other end should be carried upwards, along the back of the patient, and fixed either directly, or by means of a cord, to a staple driven into a rafter, or door-post, of the room. It is hardly necessary to mention that some care must be taken to avoid the genital organs. When the counter-extension is complete, the patient should be moved bodily downwards, to render that part of the apparatus tight. Wash-leather, wetted in a fold of four or six thicknesses, should be applied round the ankle, and not above the knee, for reasons given in the introductory remarks on this subject. A piece of cord, of about two feet in length, should be carried across the middle of the sole of the foot, and passed upwards, along each side of the leg, and fixed on the wash-leather, by means of a second piece of cord encircling the leather two or three times, and tied firmly. The ends of the first cord may then be turned downwards, and tied at the sole. Thus we can effect uniform extension, from both sides of the leg. The two loops of the cord crossing the sole should then be drawn equally tight, and to these the extending cord should be applied, passed through the pulleys, and fixed to the opposite staple.

The person of the patient should be inclined about a third of the half-circle round to the opposite side. The direction in which extension is to be made depends on the nature of the dislocation, *i. e.* the position of the head of the bone. If on the dorsum illi, the extension should be longitudinal, or nearly so. If backwards on the dorsum acetabuli or ischiatic notch, the line should be more forwards. This variety in direction is not to be effected by the alteration of the line of the extending force, but by that of the attitude of the patient, whose trunk should be fixed forwards at the shoulders, not by curving the spine, but by raising him fully, so as to carry the line of the counter-extension further backwards, or at an angle of about forty-five degrees with the patient's back. The body should be retained at this angle across the bed, or at least across the extending power (if the bone be dislocated backwards), by a person sitting behind him, or by a broad bandage brought round his shoulders.

Slight extension should now be made, to see what direction the line will take, when it is rendered more complete. Any error may yet be rectified, such as the galling of the extending agents, of the future extent of which the patient may be able already to form

some idea, and the line of extension and counter-extension must be ascertained to be perfectly straight. The extension may now be remitted and chloroform administered to the full effect of unconsciousness, and it may be repeated throughout the attempt, if suffering be great.

The position of the surgeon is at the side of the patient, with his hand on the dislocated bone, from which, having satisfied himself that the apparatus is thoroughly well applied, he should not stir during the operation. If the dislocation be on the dorsum, the bone, under the influence of steady but slow extension, will descend in a straight line behind the acetabulum. When it has reached the lower level of the cavity, it is recommended to raise the limb, and suddenly rotate the shaft outwards, with a view to turn the head over the brim into the socket. This effort may now be made, but I do not think it will be found to advance the case. If the head have descended sufficiently low, I believe it will enter the socket *without manipulation;* if it do not, extension should be continued, and slowly increased every three or four or five minutes. Supposing the patient to be under the influence of chloroform, a second attempt at rotation outwards is generally made. I believe it will be equally unsuccessful, and if so, and the head be perceptibly descending, the extending power should be continued, when the bone will pass, more or less audibly, into the acetabulum, at a moment, perhaps, immediately *following* the manipulative efforts of the surgeon.

In the three varieties of dislocation above given, whether on the dorsum ilii, dorsum acetabuli, or ischiatic notch, nearly the same management is required, with the one exception of the line of extension, which is subject to the modification I have mentioned.

In dislocation on the obturator foramen, if the patient be of moderate muscular development only, a good mode of proceeding is that of placing him against the lower part of a four-post bedstead, in the sitting posture. He should be fixed to the post by means of a sheet; a pillow should be placed between the post and his pelvis. Extension should be made by at least three persons longitudinally, or very slightly across to the opposite side of the affected limb; the operation of which will resemble, in some respects, that of the heel in the axilla. Extension longitudinally should be fully made, before the direction be changed to the oblique line across, and this should be resorted to very sparingly.

Should this plan be persisted in for fifteen or twenty minutes without success, the patient should be placed on a mattress, and the extending agents applied, as in the former dislocation, but with this difference, that the patient is placed on his back. In dislocation on the obturator foramen, the bone may be carried in a direction a little outwards; and in dislocation upwards on the os pubis, the pelvis may be raised before the extending agents are fixed, by solid cushions placed underneath it, to the height of about six or nine inches. Under either of these circumstances, the line of extension will be such as to carry the bone sufficiently in the direction of the acetabulum to give it the best chance of reaching its cavity, by bringing it within the range of the co-operative action of its own muscles. Let me again urge the value of steady and patient persistence in moderate extension, and more especially in cases of difficult reduction. It is better to resort to an endurable effort for a longer period than to attempt reduction by violent means, the result of which may be more or less injurious to the limb throughout life.

In the year 1845, I was called with two senior members of the profession to a case of dislocation of the femur. The bone was thrown upwards underneath the vessels on to the os pubis. The force of the pulsation of the artery was greatly diminished by the pressure of the head behind it; the limb was placed longitudinally; but it was obvious, on examination, that the shaft, owing to the forward position of the head, took an oblique direction backwards. The limb was flattened at the trochanter. It was proposed by my colleagues to draw the head of the bone backwards, but chiefly outwards, by a side towel. I expressed my doubt as to the probability of success, and the attempt proved that I was right. The error consisted in the direction in which the extending force was being made; the principle was bad. The case was then given into my charge, and I made extension downwards and a little outwards. The bone came down very palpably, and in descending, became less and less prominent. This was so far satisfactory, as I knew it must be advancing sufficiently in the direction of the joint. Still I had not the concurrence of my colleagues. Moreover, we differed about the requisite degree of extension; they approved of increasing, I of retaining, the force employed. When the head had descended very low, I said I would relinquish the attempt if the head did not enter the acetabulum in three minutes; but I protested against a repetition

of side extension. Within the time prescribed the bone passed with a shock into the socket.

I have had many examples of the same kind, both in reference to this and other dislocations, in which confidence in the restorative action of the muscles has always superseded the necessity of interference by lateral movements, rotation, &c., which are no less inapplicable to dislocation on the dorsum ilii with inversion of the limb, than to that I have last spoken of.

After reduction, a bandage may be tied loosely around the two knees, and the patient placed in bed. In a week or ten days, some motion may be allowed to the joint, which will have sufficiently recovered, in the course of three weeks, to enable the person to resume any ordinary occupation. If the muscles were torn asunder, probably many more weeks' confinement would be required for this purpose.

DISLOCATIONS AT THE KNEE-JOINT.—DISLOCATION OF THE PATELLA.

The dislocation of the patella may take place either outwards or inwards, but the former occurs almost invariably. This fact is due to its position, and to its relation to the muscles of the thigh, being placed at an angle between their extremities.

The neck of the thigh bone is necessary to the existence of the large muscles on the inner side of the thigh, viz., the pectineus and triceps adductor muscles, for without the neck, the two extremities would have been placed in contact, and descended in a straight line from the hip-joint. The existence of the neck demands obliquity in the shaft of the bone, and this obliquity creates an angle between it and the tibia below, which is parallel to its fellow. On this angle the patella is situated, which may be said to form a part of the quadriceps muscle, consisting of the rectus, cruræus, and two vasti, of which all above the patella is oblique, and all below, viz., the tendon, or ligamentum patellæ, is straight or parallel to the opposite tendon. If the quadriceps be put into sudden and uncontrolled action, with a force beyond the sustaining power of the fibrous and synovial membranes of the inner side of the knee-joint, the patella will be drawn over the outer condyle of the femur, and dislocated.

In women, having a broader pelvis, the liability to this injury is yet greater, and still more so, when the obliquity of the thigh bones

inwards is combined with that of the tibia outwards, as in knock-kneed persons, in whom we find the severest cases of this kind.

The causes of dislocation of the patella are chiefly muscular action, but are occasionally the result of violence. Any muscle in the body may be the occasional subject of spasmodic contraction, in which it acts independently of its coadjutors. In the act of flexion, this condition of the quadriceps may be the cause of displacement of the patella outwards, in persons having rather more than the ordinary obliquity of the femur, and dislocation outwards follows, in which the under surface of the patella lies in contact with the outer condyle. If the obliquity be great, the patella may be thrown partially or entirely over, on its back, with its cartilaginous surface upwards; but I have never seen but one example of complete reversion in the bone, and that occurred many years since, in the person of a knock-kneed dwarf, which was restored with great difficulty to its position.

Dislocation inwards is always the result of external violence, and is generally accompanied by other forms of injury, such as fracture. A heavy weight falling on the knee, or a fall from a height may produce it. The joint may be extensively injured, and the patella fractured in any direction. The symptoms of dislocation of the patella are obvious. The bone lies on the outside of one condyle, instead of between them, and the movements of the limb are impaired, though not destroyed. The patella is fixed, and has lost its easy lateral movements, while occupying its natural position on the two condyles.

The principle of reduction consists in obtaining perfect relaxation of the muscles, which hold it in its false position ; and this is effected by raising the thigh very high on the pelvis, and extending the leg, to relax the ligamentum patellæ. While the leg is forced upwards towards the vertical line, the surgeon should press the patella over the condyle with such force as is required. This, however, is sometimes a difficult task, and requires persevering exertion to accomplish. The same object, viz., that of relaxing the quadriceps, will be answered by placing the patient upright in the sitting posture in bed, leaning a good deal forwards, however, and making slight elevation of the leg only. Under some circumstances this position may be more convenient than that usually resorted to. When reduced, the knee should be rolled lightly, and placed in a comfortable position in bed; or, if not rolled, the knee may be supported by a pillow

placed under it, by which a little permanent extension of the muscles and patella is insured.

Within the last two months, I have seen two cases of what might not unreasonably be termed spontaneous dislocation of the patella. The first occurred in the person of a girl of about twenty, who found her patella dislocated, when she awoke in the morning, or was probably awaked by it. I have never seen a case of reduction so difficult of accomplishment as this. The girl was a patient of Mr. Stanley's, and on two occasions did the attempt to restore the bone baffle the best efforts of himself and several assistants; on the third occasion, the bone was reduced with great difficulty, but immediately escaped from its position; again was replaced, and again escaped as before. Finally, the bone was retained. The whole limb was rolled, and the girl left the hospital cured. A week after this occurrence, I was sent to see a lady who had just recovered from a confinement. On waking from sleep, about three weeks afterwards, she found her patella dislocated; she was fully aware of its nature, having, on a former occasion, sustained the same injury. The bone was readily replaced, and a knee-cap ordered to be worn continually over the joint.

DISLOCATION OF THE TIBIA.

The separation of the tibia from the condyles of the femur is a rare accident, and can only be the effect of great violence from external causes. The tibia may be forced backwards, so that the condyles project in the front of the joint, either partially or entirely. The looseness of the skin and of the synovial membrane is so great as to permit a considerable separation of the bones, without compound dislocation; yet even that accident occasionally comes within the range of hospital practice. The bone may also be dislocated forwards. We have partial displacement laterally, from falls or severe contusions, in which either condyle may occupy the situation of the other. The symptoms of either of these forms of injury must always be sufficiently apparent, if complete of its kind, and would be known, on comparing it with its fellow joint, by the irregularity of its form, and by the abnormal projection of the condyle, on the side opposite to that to which the tibia is carried; by the fixed position of the limb, which admits of neither flexion nor extension. Moreover, the line of the tibia is distorted from the knee downwards,

especially in dislocation of the tibia backwards, where the bone appears to project forwards along its entire line. In these accidents the ligaments are less extensively lacerated than the apparent distortion of the joint would lead us to suspect, and particularly so, in the partial dislocation which consists in the twisted position of the tibia on the femur. If this twisted relation of the bone occur inwards, the crucial ligaments, or one of them, must be torn partly or entirely; whereas, when twisted outwards, these ligaments are nearly separated from each other, or uncrossed.

The simplest mode of reduction of all these forms of dislocation of the tibia at the knee-joint is that of extension, accompanied by slight lateral motion of the joint, and pressure of the dislocated bone in the direction of the socket. It is very undesirable to make any attempt to bend the joint until the extension is considerable, and has been continued for some minutes; and, generally speaking, the difficulty of reduction is not great. If the swelling be moderate only, a wet roller may be applied around the knee, and the limb placed in a straight position, and the application of a splint along the back of the limb, if there be any disposition to starting of the muscles, or spasm.

DISLOCATION OF THE SEMILUNAR CARTILAGE.

This accident is one of occasional occurrence, and its chief feature is severe pain in the situation of the dislocation. Sir A. Cooper refers it to the toe striking some unexpected object on the ground. I have never had the opportunity of verifying this opinion, though I have seen cases of the kind. The limb is placed straight; the knee not much distorted in its form. The inner cartilage is, of the two, the more subject to this accident; in which it would appear that the cartilage has escaped from its connections, and caught between the bones; and, on examining the joint, a slight fullness presents at the side of the knee, along the line of junction, between the condyle and the head of the tibia. The attempt to bend the joint creates severe pain, although it is flexible by the agency of another person. Extension of the limb, and at the same time making moderate pressure with the hand on the opposite side of the joint, relieves the cartilage, which immediately resumes its natural position, and the pain suddenly ceases. After all these accidents about the knee-joint,

the patient should wear some instrument which maintains pressure over the joint, such as a bandage or a knee-cap.

DISLOCATION OF THE FOOT AT THE ANKLE-JOINT.

The ankle-joint is a limited ginglymus, and is formed between the astragalus below, the tibia above, and its projecting process on the inner side, or malleolus; and externally, by the malleolus externus, formed by the fibula. Of the two malleoli, the external has considerably the larger surface entering into the structure of the ankle-joint. The tibia is fixed to the bones of the foot by an internal radiating ligament, which, descending from the malleolus, is attached extensively below to the astragalus, os calcis, and to the theca in front, that binds down the tendon of the tibialis posticus muscle. The external lateral ligament, descending from the fibula, is oblique from above, backwards and downwards, to the os calcis; and an anterior and posterior ligament, nearly horizontal in their direction, are attached to the astragalus. Behind the malleolus externus pass the two tendons of the peroneus longus and brevis; of which the longus passes forwards along the outside of the os calcis, enters a groove in the cuboid bone, and runs obliquely across the sole of the foot to the root of the great toe. The brevis is inserted into the metatarsal bone of the little toe. The action of these two muscles is that of drawing the foot outwards, as though to direct the sole of the foot from the body. Behind the malleolus internus pass the tendons of the tibialis posticus and flexors of the toes, of which the flexor of the great toe passes through a groove in the under surface of the astragalus. The tendo-Achillis, formed by the muscles of the calf, is inserted about one inch behind the tibia, into the extremity of the os calcis. In front of the joint pass the tibialis anticus, descending to the os naviculare, and the extensors of the toes.

The foot may be dislocated forwards, backwards, inwards, or outwards. It is the general opinion that the dislocation outwards is the most common; but I have seen a larger proportion backwards;—such is the result of individual observation.

The separation of the bones may be partial or complete. In short, the ankle-joint is the subject of each variety, and every stage of each form of dislocation of the foot from the bones of the leg.

Of these, the dislocation of the foot forwards on the tibia is, perhaps, the least common, and that outwards the most so.

The cause of these injuries is usually a fall, or violence from a heavy body, but more commonly the former. It is difficult to obtain clear evidence on this head from patients; but we may conclude that each form of the above dislocation is the result of violence directed upon the foot in the direction opposite to that in which the bone is thrown. For example, if, in falling, either from a height or with unusual force, the foot come into contact with the ground when drawn outwards, or should it meet with an obstacle, sloping inwards, in an oblique direction to the sole, the foot would be thrown out. But displacement may also result from the application of violence on the lower part of the tibia, while the foot is fixed on the ground in the horizontal position of the body, and placed vertically. I knew a case of dislocation of the foot backwards occasioned by a heavy cask falling on the leg in this position; but almost invariably the force is applied to the foot, and not to the leg.

In dislocation outwards, the foot is twisted, with the sole directed towards the fibular side of the leg. The internal lateral or radiated ligament is either stretched or lacerated, according as the dislocation is complete or incomplete. If incomplete, the astragalus, instead of being adapted to the fossa in the tibia, is thrown obliquely outwards, having its tibial surface directed to the malleolus internus, and the outer edge firmly fixed against the tibia. The external lateral ligaments remain entire, and the malleolus externus sustains the pressure of the bone outwards. The foot is more or less distorted in form, and is incapable of being either bent or extended. If complete, the internal lateral ligament is more extensively, or is completely rent asunder; the outer surface of the astragalus is in contact with the fossa of the tibia, and the force of the concussion, coming against the malleolus externus, breaks the fibula from two to three inches above the ankle-joint, forcing the lower piece of this bone in an almost horizontal direction outwards. The sole of the foot is directed outwards. This is occasionally known by the term of Mr. Pott's dislocation. If the flexor pollicis has not escaped from the groove in the astragalus, the great toe will be bent downwards, and extended not without pain or difficulty; and, indeed, the violence of the concussion may be in some degree gauged by this fact. The peronei muscles are relaxed by the position of the foot.

In dislocation of the foot inwards, its relation to the leg is appa-

rent, if compared with the opposite leg; but its distortion is not so complete as in the last dislocation; the malleolus is occasionally, but not frequently, broken off. This dislocation is, I think, more frequently a partial one than that outwards. The tendons of the peronei are tense, by reason of the elongation of their attachments, and the foot is fixed. A duplicature of integuments occasionally forms below the inner malleolus. The upper surface of the foot slopes outwards. The external ligaments are stretched or torn.

In dislocation of the foot backwards, the astragalus is thrown out of the fossa, either partially or entirely. If partially, the force has been inadequate to a total rupture of the lateral ligaments, and the two articular surfaces are still in contact, but in an abnormal relation to each other. If complete, the tibia lies forwards, across the foot, upon the navicular and cuboid bones. The length of the

Fig. 14.

upper articular surface of the astragalus is about an inch and a half; and a fair judgment of the extent of the dislocation may be formed by admeasurement, taking the distance from the centre of the malleolus internus to the extreme surface of the heel. The lateral ligaments, if not entirely torn asunder, must be partially severed, and the position retained by the remaining fibres. The distance from the front of the tibia to the toes is unnaturally short; and that from its back to the heel proportionately long. The lower part of the tendo-Achillis appears to pass obliquely backwards, instead of vertically, to the os calcis. There is often a fold of integument at the inner ankle. The foot is fixed, but, as is the case, perhaps generally,

in these dislocations, is less firmly fixed in partial than in complete displacement of the bones.

Dislocation of the foot forwards from the tibia is a more rare form of accident than that last described. It may be so partial in degree

Fig. 15.

as to raise a reasonable doubt of its existence; but it may be known by the approach, closer than natural, of the heel to the posterior surface of the tibia, by the length of the foot in front of the bone, and by the fixed condition of the joint. Yet I have seen two cases in which the opinions of experienced men were in opposition as to the presence of dislocation, so slight was the displacement.

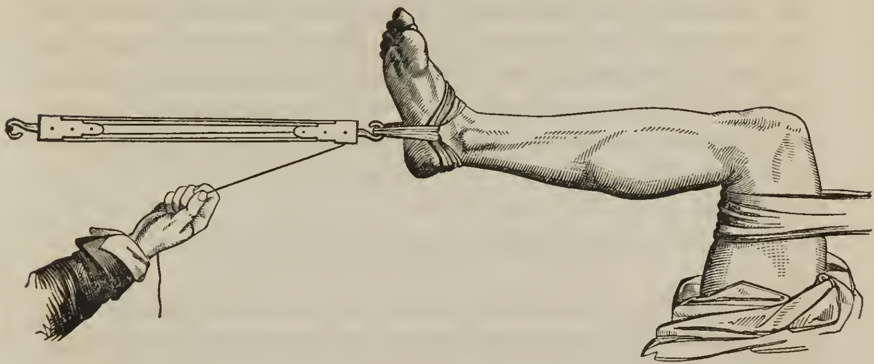
In complete, or nearly complete dislocation forwards, we have little difficulty in forming an opinion. It is only in the incomplete forms of injury that the difficulty prevails. Comparison with the opposite foot, the previous normal condition of the limb, the evidence of an accident, will establish the fact of an injury sustained; negatively, the absence of fracture, of dislocation either backwards, inwards, or outwards; and positively, the proximity of the heel, the length of the front of the foot, and its fixed state ought to lead to the only one conclusion, viz., that the foot is thrown forwards from the articulation. In lateral dislocation the foot presents more or less a twisted appearance, but not so when in the direction forwards or backwards.

The reduction of all these forms of dislocation is effected by the application of the same principle so frequently urged, viz., extension. The joint is so firmly fixed, both by muscles and by ligaments, that

any attempt to reduce the dislocated bone by the hand will prove nugatory. The pulleys should always be resorted to, so great is the strength of the agents of retention, whatever they may be. Nor have I ever failed in the application of the following method.

The patient should be placed on the dislocated side, and his knee bent at a right angle. Around the lower six inches of the thigh, a broad and strong bandage should be applied, the two ends of which should be carried upwards, in the line of the leg, and fastened to a staple in the wall. The ankle should be encircled by a strong coarse

Fig. 16.



roller, of about four or five thicknesses, which should be applied wet, and very loose, between which and the leg a second roller, doubled, should be passed on both sides, and round the sole, and tied. When extension is made on the wet roller around the ankle, it will be drawn below the malleoli, but will not admit the passage, through the circle thus formed, of the os calcis. The rope and extending pulleys are applied to the second roller, and extension is then commenced. The surgeon standing at the foot, close to the side of the cord, which may pass through his legs, takes the foot in front, and also at the heel, in his two hands; and when the extending force has been applied for a few minutes, he draws the foot in the opposite direction to that of the dislocation. If dislocated either outwards or inwards, it will probably return to its natural position without any manipulation; if forwards, or backwards, the foot should be played a little in the action of flexion and extension on the tibia. The extending power should be persisted in for ten minutes, or somewhat longer, but if the apparatus be well applied, and the extension considerable, I have

found a period of five minutes suffice to reduce any one of the above forms of dislocation. After the reduction, a wet roller should be placed around the joint and cold applied, if it exhibit any tendency to swell.

After the reduction of dislocation of the foot outwards, with fracture of the fibula, some care should be bestowed on the position of the foot in bed, otherwise, as Mr. Pott has remarked, the peronei will tend to draw the foot outwards, in consequence of the fractured fibula failing in its natural support to the outer surface of the astragalus. The leg and foot may be, however, safely placed on the outer side, supported on a well-padded splint, and with the addition of the foot being raised, by directing the sole slightly upwards. I can bear no personal testimony to the liabilities first announced to the profession by Mr. Pott, never having witnessed them, although, mechanically, the anatomy of the parts involved would point to their occurrence as not improbable.

DISLOCATION OF THE ASTRAGALUS.

The astragalus, although fixed below to the middle of the os calcis by a very strong interosseous ligament, and to each malleolus by the lateral ligaments, and by a dorsal ligament to the navicular bone, is occasionally the subject of dislocation, even, indeed, to the extent of its complete reversion.

It may be thrown upwards and inwards, and upwards and outwards, depending on the direction of the force applied. It has also been thrown inwards in front of the malleolus internus. A not unlikely cause of this injury is one recorded by Dupuytren, in which a person alighted from a height on his heel, and the astragalus was thrown forwards on the navicular bone. Although the astragalus may be the occasional subject of single dislocation, I am not convinced that every case recorded by authors were cases of this kind, so generally is this injury complicated with the displacement, either partial or complete, of other bones of the foot. When simple displacement has occurred, the relations of the remaining bones to the tibia are undisturbed; the astragalus, whether thrust forwards, outwards, or inwards, being jammed in between the tibia, calcaneum, and navicular bones; but if the sole be directed outwards or inwards, and if the relation of the entire foot to the tibia be altered, so that the distance between that bone and the tendo-Achillis be either lengthened or

shortened, the case would assume the form of dislocation of the foot, to which that of the astragalus from the foot is superadded.

The difficulty of reduction is, perhaps, increased, rather than otherwise, if the case be that of simple dislocation, for the bone in its new position is so indistinct in form and relation that it is impossible to ascertain the precise obstacle to its return; and excision of the bone is the not infrequent resort of the surgeon, nor do I know any other alternative when the bone is reversed excepting that of trusting to nature's disposition to reconstruct or remodel the joint, which, in the case of a young person, would not be improbable.

The attempt at reduction should be made by fixing the leg as in the former dislocation, tying a clove hitch of cord over a roller, applied around the foot, behind the metatarsal bone of the little toe; while the foot is drawn downwards at the toes and at the heel, the astragalus should be pressed backwards with force. If this fail, the foot should be drawn *forwards* from beyond the metatarsal bone of the little toe. The obstructing tendon or tendons may be divided without serious damage, if there be reasonable ground for this operation.

The consequences either of leaving the bone in its abnormal position, after violent attempts have been unsuccessfully made to reduce it, or that of excision of the bone, are sufficiently formidable in their result to justify any reasonable attempt to replace it. Among other measures that may be resorted to, is the division of the ligaments, and especially the internal plantar, or calcaneo-navicular ligament; and considerable space would thus be afforded by which to reduce the bone to its natural position. Of course it should be a subcutaneous operation. When divided, the foot may be forced a good deal outwards, and space probably allowed for the return of the bone.

The same principles will apply to dislocation of either of the remaining tarsal bones, the reduction of which is far more easily effected. With respect to dislocations of the metatarsal bones and phalanges of the toes, they have no distinguishing feature to render it necessary to resort to agents different from those applied to the reduction of dislocations of the upper extremity.

Dislocation of Nasal Cartilages.—Among other kinds of dislocation, that of the nasal cartilages should not pass unnoticed. We have two cartilages on either side of the nose, the upper one attached to the extremities of the ossa nasi and superior maxillary bones, and

a second elliptical piece forms the aperture of each nostril, while the septum nasi, occupying the centre, forms the partition between them. A violent blow may displace any or all of these cartilages from the ossa nasi, and from the nasal processes of the superior maxillary bones, and flatten the nose to the level of the nasal bones; or, by still greater violence, fracture these bones or separate them from the frontal. The nature of the injury can scarcely be mistaken, although the knowledge of its full extent requires examination. The evil will be somewhat increased if the dislocation be a compound one, and if much of the cartilages or bone be exposed. The future appearance of the individual will depend on the greater or less care bestowed on the reduction. The nose is so important an organ of the face, and on which its character so much depends, that its restoration is of no ordinary moment, and should engage the best efforts of the surgeon. After a careful examination, and the parts cleansed of blood, the little finger should be oiled and passed up the nostril as high as possible, for the purpose of prizing up the broken bone or bones, whether nasal or maxillary, for both are occasionally fractured. As it is impossible to effect much benefit by the ordinary principle of extension, the organ should be moulded by the finger, the bones first replaced, and then the cartilages upon them. If the nostril be small, the scoop end of a director may be employed for this purpose. The contour of the nose should be preserved as much as possible; and, as happened on one occasion in my own practice, should even be improved in outline if possible. If the fracture be comminuted, the cavity may be filled with cotton wool, or even by some firmer material, which will give support to the nasal bones, while lateral pressure is made on the external surface by nicely-adjusted lint and plaster. Any wounds of the skin should be very carefully united by fine sutures.

DISLOCATIONS WITH FRACTURE.

The description which has been given in this chapter relates almost exclusively to the dislocations of the respective bones from their articular cavities, in their unbroken state; but dislocation, accompanied by a fracture of the dislocated bone, is no unusual accident, and presents difficulties to the surgeon of a very formidable kind. Of these, the most common are fractures with dislocation of the head of the humerus; fracture of the ulna, or radius, or both,

with dislocation of one or both bones; fracture of the lower end of the radius, with dislocation of the carpal bones and hand; fracture of the condyles of the femur, with dislocation of the patella; and fracture of the lower end of the tibia or fibula, with dislocation of the foot. The difficulty may be still further complicated by the compound nature of the injury by which the joint is more or less exposed to view. This difficulty consists in the impossibility of influencing the dislocated portion of the bone by extension, provided the separation be complete. As a general rule, the fractures alluded to take place between the head of the bone and the muscles acting on it from above; for example, that of the head of the humerus separates the head more or less obliquely from the shaft, above the attachments of the pectoralis major and latissimus dorsi, but not above the scapular muscles, viz., the supra-spinatus, infra-spinatus, teres minor, and subscapularis. In the elbow-joint, the brachialis anticus and triceps are inserted into their respective bones, closely in contact with the joint, whereas, in all the remaining examples, the insertion of the muscles is farther down the bone. If the end of the broken bone be insulated, it is quite obvious that any form of extension will be unavailable. If the head of the humerus be the seat of the injury, it is probable that it yet retains its connection to some, if not to all the muscles inserted into the tubercles, which, in surgical language, form a part of it, although it be totally separated from the shaft of the bone below.

The first indication points to the restoration of the dislocated bone. To accomplish this, the most strenuous efforts should be made, by the employment of every reasonable device that the knowledge and experience of the surgeon can command. Although we cannot command the movements of the head of the bone, we can, at least, influence the position of the glenoid cavity, which should be forcibly directed towards the head of the bone. However, all will probably prove unavailing. The next question arises, what is best to be done in order to restore the limb to the most serviceable condition in future? Is it preferable to leave the bone untouched, and trust to nature to restore it to future utility, as in the case of ununited fracture, in which the muscles have adapted their actions to the necessity of their position; or to attempt the union of the fractured surfaces, with the probable attendant evil of permanent dislocation? There can be no doubt that the latter course is that which offers the fewest objections, and its adoption is not incom-

patible with perfect recovery. With this view the two surfaces should, if possible, be brought into close contact, and the limb kept at perfect rest, however peculiar the position, or the means employed to effect it. Should the bones unite, which is most probable, unless unfortunately any of the soft structures around should intervene, nature will form a joint to suit its movements. Imperfect, indeed, in its construction, when compared with the original joint, but susceptible of extensive and serviceable movements, notwithstanding. Here then the case may rest, provided the patient be satisfied with the condition of the limb. This, indeed, will depend in some measure on his station of life. When the bone is firmly united, or at the expiration of seven or eight weeks for the humerus, and five or six weeks for the radius and ulna, an attempt may be cautiously made to move the head from its attachments; and should this succeed, the application of a well-regulated extending force, which should rely on the efficacy of time, rather than of power, may succeed in restoring the joint to its healthy condition.

The above remarks apply to injury of the shoulder and elbow-joints. In the examples of the same accident befalling either the knee, wrist, or ankle, the same extent of difficulty does not prevail. If the injury be so great as to preclude a hope of restoration of the joint, nothing remains for us but to place the limb in such a position as will meet the most important services to which it may be hereafter called.

It is important to recollect, in reference to fractures in the neighborhood of joints, the liability to separation of the epiphyses in young persons. Such accidents occur about the shoulder-joint, by the disjunction of the epiphysis of the humerus at the elbow, by that of the olecranon or coronoid process of the ulna, or of the articular extremity of the humerus, and at the wrist, by the separation of the articular extremity of the radius. The same accident may happen to the femur at the knee-joint, or to the tibia at the ankle.

The separation of the epiphysis from a young bone is effected with a less degree of violence than is required to break the shaft of the same bone; and should such a fracture occur in the neighborhood of a joint, in children below twelve or fourteen years of age, in a line corresponding with that of the epiphysis, it may generally be presumed that the apparent fracture consists in a separation of this process. Practically, it is not very important, because the treatment would not differ from a fracture of the same line of bone after union is completed between the epiphysis and the shaft. Less time, however, would be required to repair the injury in the younger subject.

CHAPTER IV.

ON BANDAGES.

VALUE OF BANDAGES TO THE SURGEON. — IMPORTANCE OF ACQUIRING SKILL IN THEIR APPLICATION.—USES OF A BANDAGE.—MODE OF APPLICATION.—THE COMMON BANDAGE.—THE T BANDAGE.—THE FOUR-TAILED BANDAGE.—THE MANY-TAILED BANDAGE.

In the following brief chapter is included a description of the four or five forms of bandage in most common use, with a general reference to the kind of malady in which their services are employed.

In no department of surgery is the improvement, which has of late years taken place, more strikingly exemplified than in this; and it is a fact well worthy of observation, that, as we advance in scientific knowledge, so have elaborate and complicated contrivances gradually yielded to the simple bandage, now almost exclusively employed. This application, properly made, answers, with some few exceptions, every useful purpose, although skill and ingenuity may occasionally be required to meet the demands of individual cases.

The common bandage consists of a strip of strong unbleached calico, without seam or selvage, varying from one to ten or twelve yards in length, and in width from one to five or six inches. It is firmly rolled up for use, and hence is commonly called a *roller*. Sometimes linen or flannel is the material employed, the latter being selected for the sake of additional warmth. Elastic bandages, made either of a fabric like stocking material, or of Indian rubber web especially, are also often employed with great advantage.

Bandages are applied for various surgical purposes, viz., to protect a diseased part from injury—to confine dressings, &c., in their situation—to restrain movement—to assist union where a solution of continuity has occurred—to support parts in a state of debility—to restrain hemorrhage by compression—to oppose certain displacements of the viscera, and to prevent or rectify deformity, by holding the dislocated parts in a natural relation to each other.

Skill in the application of a bandage is not to be acquired by any description; it can only be obtained by frequent practice; and I would earnestly advise every student to lose no opportunity of becoming a thorough proficient in this department of his profession. It is a subject which, in relation to its importance, is neglected, I believe, beyond all others. A bandage is not successfully applied with the facility imagined by those unpractised in the resort to it. Many surgeons, who can perform a capital operation not without eclat find great difficulty in the application of a simple bandage, and execute this really important part of their duty most imperfectly. Such an exhibition presents a warning and a useful lesson to all around. There is no excuse for the neglect of this subsidiary art; the opportunities for practice are always abundant; there is every motive for the acquisition of skill, and its possession is a duty we are all liable to be called upon constantly to exhibit.

The common examples in which the use of bandages is required are cases of ulcers, varicose veins, or other affections of the leg, and fractures. It is impossible to enter into detail, but when once the art of bandaging is acquired, it is very easy to meet the demands of each individual case. The general object is to apply the bandages smoothly and evenly, to ensure an equal pressure on the surface beneath, and to employ no more than is sufficient for the required purpose. If parts are liable to swell, allowance must be made for the difference of size. We must remember that, if the bandage be wetted, it will become more tense, but will become loose again on drying. These ends are best attained by commencing at the extremity, and applying the bandage most tightly in that situation, and gradually and almost imperceptibly remitting the pressure as we ascend; the roller should be kept close to the surface, and not more of it unrolled than is necessary; each successive fold should overlap about one-third, or one-half of the preceding. In order to apply the bandage smoothly to parts of unequal diameter, we double it upon itself. We will take one example by way of illustration.

Suppose it is necessary to apply a bandage to the leg in a case of varicose veins. We commence by placing the extremity of the bandage on the dorsum of the foot, and surround the metatarsus by a few turns; the roller being passed from one hand to the other, the bandage is then carried up obliquely across the tarsus from within outwards, round the ankle, and back again. It is better to carry the bandage up on the inner side of the instep, in order to support the

arch of the foot. This manœuvre is again repeated, care being taken to enclose as much of the heel as possible, and the bandage is then rolled spirally up the limb. As the leg increases in diameter, the roller is to be reversed, or folded sharply over on itself, guided by the finger. (*See* plate.) The bandage is continued in

Fig. 17.

this manner up the leg as far as is required, usually to a point immediately below or above the knee; a few circular turns are then given, and the end fixed either by a pin, a few stitches, a piece of adhesive plaster, or by splitting the end of the bandage longitudinally for a short distance, bringing the ends round the opposite sides of the limb, and tying them together. A bandage well applied has a very neat appearance; it lies smoothly; the lower margin of each fold is seen at equal distances, at which the inflections are placed. These inflections are generally made over that part of the limb requiring the greatest pressure.

The T bandage is sometimes employed for giving support to the anus, perineum, scrotum, &c. It consists of a circular portion of

considerable breadth, which passes round the loins, and a perpendicular piece, which descends from the back, passes between the thighs, and then ascends to be fixed in front. The circular portion may be supported by means of bands passing over the shoulders. The perpendicular portion may be provided with a pad, covered with oiled silk and split longitudinally in front, &c., according to the necessities of each case, each end being drawn over the corresponding groin.

The four-tailed bandage is a very useful contrivance. It is generally employed in fractures of the lower jaw. (*See* plate.) This is

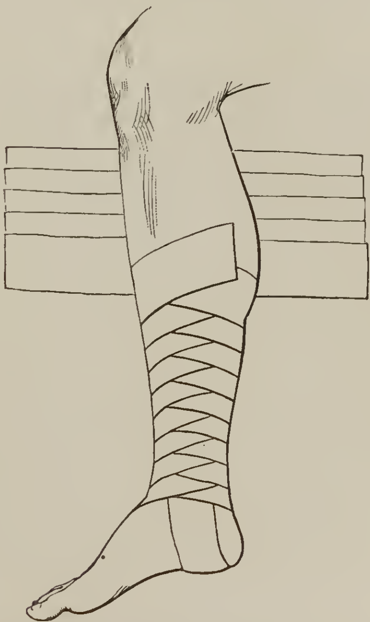
Fig. 18.

required for keeping dressings on the head, knee, &c. It consists of an oblong piece of calico or linen of requisite size, split up the middle, at each end, nearly to the centre. If applied to the head, the middle portion is placed towards either the front or back, according to circumstances; the anterior ends are brought backwards, under the occiput, and either tied there, or brought round the neck and secured in front; the posterior are fastened under the chin.—(*See* plate.) Its mode of application to the jaw or other parts is obtained by reversing the above position, viz., by applying the central broad part to the chin, around which it is made to fit by carrying two ends vertically to the summit of the head, and the other two backwards round the occiput. These ends are then united to each other by a vertical piece.

Fig. 19.

The many-tailed bandage is sometimes, though rarely, employed in cases of fracture of the leg. It consists of a longitudinal portion,

Fig. 20.



and a sufficient number of transverse pieces, proportioned in length to the circumference of the part to which it is to be applied. The

transverse pieces are laid across the longitudinal portion, a little obliquely, each somewhat overlapping the one above, and fixed by a few stitches; the limb is laid upon the longitudinal strip, and each pair of the ends are necessarily brought across in front of the limb, commencing with the lowest.—(*See* plate.)

Additional information on this subject is given elsewhere.—*See* Fracture—Dislocation—Hernia—Cataract, &c.

CHAPTER V.

ON FRACTURES.

NEGLECT OF TREATMENT OF FRACTURES BY BRITISH SURGEONS.—INDUSTRY REQUISITE RATHER THAN SKILL.—SIMPLE FRACTURES.—COMPOUND FRACTURES.—COMMINUTED FRACTURES.—TRANSVERSE, OBLIQUE, LONGITUDINAL FRACTURES.—CAUSES OF FRACTURE.—INFLUENCE OF THE MUSCLES ON THE POSITION AND RELATIONS OF THE BONES.—OVERLAPPING OF THE BONES, AND SHORTENING OF THE LIMB.—SYMPTOMS OF FRACTURE.—CREPITUS.—PRINCIPLES OF TREATMENT.—REDUCTION AND RETENTION.—COMPOUND FRACTURES.—IMPORTANCE OF EARLY PROGNOSIS.—TRAUMATIC FEVERS.—SLOUGHING.—FRACTURES INTO JOINTS.—ANCHYLOSIS.—FRACTURES WITH DISLOCATION.—SPECIAL FRACTURES.

A CHAPTER on the subject of fractures of bone, although rarely calling for the employment of the knife, or other instruments of surgical cutlery, involves both the principles and the manipulative agency of operative surgery. It has been charged against British surgery, and not without some show of reason, that its powers, which are so largely and so successfully wielded in the cause of other diseases, have been more sparingly dealt out in the cause of a broken bone than of any other structure. This charge, if true, implies less the want of knowledge than the want of industry. The management of simple fractures claims less of professional skill than of time and labor. The principles are both obvious and simple, and in the award of responsibility between the powers of nature and of art, it must be confessed that nature performs by far the greater half of the duties required. Any part of the skeleton is liable to fracture—cranium, ribs, sternum, vertebræ, pelvis, extremities. This liability is of daily occurrence. Experience is acquired, more especially in towns and in largely populated districts, without difficulty. Every surgeon ought to be familiar with such knowledge; and, considering the healthy condition of the entire osseous system as indis-

pensable to a man's functions in life, almost whatever duties are assigned to him, he ought to be equally prepared to take the trouble requisite for its complete restoration, in case of any ordinary accident befalling it. There is some excuse in extraordinary cases; but such cases are comparatively rare. Cases of fracture of the extremities, involving joints, for example; oblique fractures in persons of peculiarly irritable habits, and severe compound fractures; but, in reference to simple fractures, whether of the trunk or extremities, and without idiosyncracy, a small amount of knowledge, with a moderate share of personal exertion, are all the requisites demanded for their complete restoration.

But, however perfect may be the resources, and however large the contribution of nature to the union of a broken bone, these resources are profitless, unless directed and controlled by art. Bones are structures of so low an organization as to influence the sensibilities of the constitution in a very slight degree so long as the bone alone is broken. The health is little disturbed; neither inflammation nor suppurative action interrupts the simple process of union up to its final consummation. The chief source of evil is derived from the necessary restraint incidental to the treatment. One is, therefore, at a loss to find any apology for those surgeons to whose want of care, and even of humanity, may be attributed the numerous examples of distorted and contracted members which have cast a reproach on the surgery of Great Britain. It is not in the management of great cases that the superiority of the surgeon is so strongly manifested, as in that of common diseases of every day's occurrence. Genius for our art may shine out on great occasions, and brilliant devices contend against remarkable deviations from health; but *conduct* is required by us all. The word *conduct* has a wide interpretation—it appeals to the application of the humanities of life, as well as to the exercise of skill and industry, in the application of our best resources to the treatment of disease.

Fractures are various in kind, and each kind claims some important modification in its management. Perhaps the most important division of this form of injury is that into simple and compound; but each variety is subject to modifications. Simple fractures, usually affecting the extremities, or the ribs, may occur in different relations to the affected bone. A bone may be broken transversely or obliquely, or almost longitudinally. The shaft of the bone may be merely divided by a transverse or oblique section, or it may be broken into many

fragments. Thus we have a comminuted fracture. The case is further complicated by the greater or less injury done to the soft structures around it. A compound fracture is defined to be a solution in the continuity of a bone, accompanied by a wound in the skin, which communicates with the fractured bone. This communication almost necessarily infers a greater extent of injury done to the soft structures of the limb than in simple fracture ; and it is not therefore surprising that so much greater difficulty attends the future progress of the case. But the exception to this general rule is not very uncommon, because a fracture may be greatly comminuted as regards the bone, and very destructive of the soft parts ; and yet the skin being unbroken, brings it within the definition of a simple fracture ; and on the other hand, a cutaneous bone, like the tibia or ulna, may, when fractured, be partially forced through the skin, with little injury to the soft structures of the limb, and still obey the definition of a compound fracture.

The causes of fractures are almost invariably referable to external violence, such as a blow or fall ; but it is indubitable that the sudden and violent action of the muscles attached to a bone is occasionally the cause of its fracture. Indeed, fractures of the patella are almost uniformly attributable to this cause alone, and occasionally also that of the olecranon. But although a fracture of a long bone by the action of its muscles is a rare accident, we meet with daily examples of the agency of this power in displacing bones that are already fractured, and, indeed, of converting a simple into a compound fracture. If the humerus be broken immediately below the coraco-brachialis, or the radius below the insertion of the biceps muscle, the sudden action of those muscles must almost necessarily exercise an influence on the position of that fragment of the bone into which they are inserted. But the influence thus exerted by these and similar muscles must be cotemporaneous with the moment of fracture ; for nothing can be more improbable than that these muscles should continue for an indefinite time to drag upon the broken bone. In cases of fracture, whether transverse or oblique, the bone is generally shortened in its length by the action of the muscles inserted into it ; but this change takes place at the time of the accident ; and so long as the limb is at rest, the shortening does not increase, even to the lapse of some hours before it is placed in splints. There is a vast difference between the extent of the action of muscles exerted on any given bone in dislocation and in fracture, as may be inferred

from the different degrees of force required to replace the bone in the two forms of accident; for the one is readily effected by the extending power of two persons, and retained by the simple application of splints, while the other requires the artificial force of the compound pulley. While I admit the efficacy of muscular contraction in shortening a fractured limb, I cannot concur with the authors of the old school of surgery in the belief that the direction taken by the lower fragment is attributable to the operation of this cause. The direction of the lower fragment is greatly determined by the direction of the blow. If the femur be broken half way down by violence applied on the outer side of the limb, in all probability the lower end will overlap the upper, and project on the inner side of the thigh. But this retraction is produced, at the instant of the shock, by the sudden action of the muscles exerted for the purpose of steadying the limb, and not by their continued action after it. The resistance afforded by a large bone or a large limb is sufficient to resist these actions after the accident, in a great degree. Indeed, the pain which their action would produce would of itself insure sufficient control to prevent further contraction. Not so, however, in the case of a large muscle attached to a small bone, as we find in the example of the patella drawn up by the rectus muscle, and the action of which often continues for some days after the accident.

The retraction of the limb is always produced by this contractility of the muscles, and hence the overlapping of one bone by the other. The projection of one or more bones at the point of fracture may be occasionally due to the action of the muscles operating on the upper portion, but not so commonly so as is supposed. In the case of the thigh, for example, there is no muscle so attached to the bone as to elevate the upper portion in any other direction than that inwards, for the long muscles of the limb have lost their influence by reason of the solution in the continuity of the bone, on which they have hitherto acted; and of the muscles connected to the upper half, we have none but the triceps, which can only act by distorting the line of the bone in the direction upwards and inwards. It will be recollected that the rectus in front passes beyond the fracture, and the cruræus and vasti arise from the upper portion of the femur, and cannot therefore influence its movements, while the flexors behind the bone extend below the fracture to form the hamstrings, and can of course only operate on the lower portion. In fracture high up, the psoas and iliacus exercise no influence in elevating the upper

end. With respect to the humerus, we may have the deltoid or the coraco-brachialis acting on the bone in the direction of their origins, in cases of fractures below the insertions; or the muscles of the axilla, in fracture still higher up on the bone; but I do not think that the projection of the upper portion of the humerus is materially influenced by their actions, which is rather to be attributed to the direction in which the force has been applied against the bone. In the case of fracture of the radius, again, we have only the pronator teres, the action of which would be immediately expended in the act of rotating the forearm. It has no power of elevating the upper portion of the bone. That the muscles exert some influence is highly probable, but I think not to the extent that has been supposed.

The shortening of the limb in fractures is, without doubt, owing to the action of the muscles immediately consequent on the accident; but I contend that this violent action does not continue, as in the case of a dislocation, and I doubt very much whether it is the cause of the prominence of the upper end, so frequently found; the truth of which observation will, I think, be confirmed, by observing more critically than is usually done the relation held by the surrounding muscles to the upper or projecting portion of the bone.

From the period of the accident, however, if neglected, the muscles of the limb commence a process of slow retraction, which will extend over many days and even weeks, as occur in some rare examples of fracture of the neck of the thigh bone, without early symptoms.

Although fractures are more frequently the result of external violence than of any other cause, yet a bone may be broken by the sudden arrest of its movements, as has occurred by placing the foot in a plug-hole, while in the act of walking. Such fractures are almost invariably oblique; while the transverse fracture is generally the product of a blow from a small body, as distinguished from the crushing effects of a large one.

The symptoms of fracture are generally unequivocal. In cases in which the ends of the bones are separated, it is characterized by pain, by shortening, by a powerless condition of the limb, by irregularity in its form, and by the sensation produced on friction of the broken ends of the bone, termed crepitus. Some of these symptoms occur in dislocation, but in fracture the injury, unless in the neighborhood of a joint, is palpably referred to the shaft. Shortening of the thigh is common to both fracture and dislocation; but in fracture, the part is more distorted from its usual form than in

dislocation, and the pain caused by the attempt to move it is referred to the shaft, and not to the joint; and should the fracture occur within a few inches of a joint, the crepitus will determine the nature of the injury without difficulty, because the bones are thick, and cannot so well overlap each other as in the case of fracture of the shaft, in which the two rugged surfaces may be brought into contact without difficulty.

The crepitus, which not infrequently attends on cases of dislocation, is distinct in its character from that of fracture. An experienced touch will generally detect the one from the other readily enough. False crepitus is caused by the friction of two rough surfaces, composed of soft material; true crepitus, of hard bone. False crepitus gives merely a slight jerk to the rotatory movement of the bone, while true crepitus conveys a sense of hard grating, perceptible both to the surgeon and the patient. Pain almost invariably attends the effort which causes crepitus in fracture, and the evidence of the injury being once clearly obtained, and it can only be obtained in many cases by a considerable effort, the surgeon should desist from its repetition. It is only in cases of doubt that the patient should be subjected to the certain evidence of violent and painful rotation. There are positive evils attendant on the occasional pressure of a superfluous array of surgeons, all of whom, animated by an earnest love of professional knowledge, are, naturally and commendably enough, unwilling to allow an opportunity to pass without improving it! Should it be necessary, for the benefit of the patient, that crepitus be felt, it may generally be rendered palpable by the slightest and the gentlest movement of the limb, when the bones are previously extended. Of course, much will depend on the limb broken, not only because the bone is more or less covered with muscles, the presence of which will necessarily mask the sensation, and render it less distinct, but because, in the case of the thigh for example, the limb is large and bulky, and is handled with more difficulty.

When a bone is broken, the muscles of the limb, taking advantage of the loss of the extending agency of the bone, draw up the lower portion, and hence shortening. The power the muscles exercise in thus reducing the length of the limb is greatly increased, if the fracture be oblique, and the ends pointed; and in proportion to the obliquity of the fracture and the power of the muscles is the difficulty of retaining the two surfaces of the bone in permanent contact,

when brought into apposition, for the obliquity of the lower end acts like a wedge, and in persons of very irritable habit, the activity of the muscles is by no means confined to the moment of the fracture, but calls for the unceasing watchfulness of the surgeon. In oblique fracture, crepitus is more readily perceptible, without elongating the limb, than in transverse fracture. If the bone be comminuted, it will be still more distinct, or at least the sensation will be attainable with a still less effort of rotation. The pressure of the splints, acting laterally through the body of the limb, often contends but imperfectly against the tendency of the bone to retract, in consequence of the wedge-shaped form of the lower end of the bone, which forces its way in spite of them. In fractures of the forearm and leg, composed as they are of two bones, and especially if without displacement, the difficulty of diagnosis is often very great, and that of the fibula especially, for we have neither shortening, nor distortion, nor crepitus. In such cases, fortunately, treatment by splints is not so necessary as in fractures of single bones, sufficient extension being kept up by the other bone.

Fractures of nearly all the bones, and particularly of the extremities, demand two distinct indications: first, the replacing or reducing the fracture, and secondly, the retaining it in a suitable position for permanent union. The first end is attained by extension of the limb, and for this purpose the surgeon should have sufficient, and more than sufficient power at his command. Having made an examination of the limb both by the eye and by the hand; having ascertained, by the exercise of his best judgment, the locality, and the direction of the fracture, whether transverse or oblique, and whether comminuted or not, his next step is to provide the means by which to retain it in position. For this purpose, either wooden or metal splints are employed. Observing the form of the limb, he will determine the number to be applied, taking care that as much of the surface be covered by the splints as possible, in order that, being extensive, a less degree of pressure is requisite; but that they do not "ride," as it is termed, over each other. If any considerable space be left between them, it will be compressed by the straps or roller applied around the splints, and create inconvenience, and even pain. The splints, however, should not be too wide or bulky. A round region of a limb will require four in number; whereas for the forearm and leg, we can conveniently adapt but two. The limb is protected against the injurious conse-

quences of the splints by pads, and much of the future comfort of the patient depends on their being efficiently made. They should be arranged by the surgeon himself, or under his immediate direction.

The material usually employed for this purpose is tow or raw cotton. If the former be selected, it is necessary that it be new and fine, and free from balls. Mr. Abernethy, who made the best pads I have ever seen, and who took the trouble to instruct me in this necessary art, used to have the linen in which the tow was inclosed laid out, and he then drew the tow from the mass in detail, by the pressure of the inner side of his hand against the table, from one end of the pad to the other. This process he continued till the whole mass, so disposed, had reached a sufficient thickness. It was then inclosed in numerous folds of the linen and sewn up. Pads are not usually made of sufficient thickness to protect the skin against the pressure of the splints, and particularly so at the ends, where the hard substance is likely to irritate and inflame the structure against which it presses. Cotton wool is also a good material; and, indeed, in some respects, is preferable to flax, being softer, and at the same time more elastic. The cotton used in wadding for dresses is objectionable. Horsehair and bran are also occasionally employed for the purpose; but every end is answered by the two first named agents, which, indeed, are more generally resorted to.

It is the custom of some surgeons of the present day to retain the old practice of applying a linen bandage, in some form or other, immediately around the limb, previous to the application of the splints. Some surround the limb with a common roller, others apply the old eighteen-tailed bandage, which is, in my opinion, a superfluous appendage in the treatment of fracture, and may be perfectly well represented by a piece of fine linen applied once or twice around the limb, extending to the breadth of a foot or more. As a general rule, unless the fracture be comminuted, both may be dispensed with. The splints should be retained by straps and buckles, instead of pieces of calico roller. The degree of tension effected by the straps can be more easily regulated. The straps, whether of thin leather or of the tape often used, should be broad, and the buckles strong, and well and firmly attached to them.

When this apparatus is completed, the fracture should be "*set.*" For this purpose the limb, suppose in the case of a fractured thigh, should be drawn out in extension by one or two persons of competent strength, employing force, steadily and uniformly made, on the

extremity. The limb may be drawn from the knee or from the ankle. The counter-extension having the weight of the body in addition, requires, of course, less power. While the extension is being made, the surgeon stands by the side and assists, by gentle movements of his hands, in moulding the bone. He may, with this object, slightly raise the fractured bone and draw it in all directions, while extension is being made, and employ pressure with his hands, first on one side and then on the other. The extension should be continued for some minutes, until the thigh has reached the length of the opposite one; but the extension should be continued, although with less force, while the splints are being applied, and, indeed, up to the moment of their being fixed by the straps. Deficient extension of fractured limbs is a common fault; if made with caution and with gentleness, it can hardly be carried too far. When the splints are properly applied, it is of little moment in what position the limb is placed; but in the case of the thigh, if the trunk be horizontal in bed, the thigh should be a little raised to the ham, and the knee may be slightly bent.

The functions of the body, during the treatment, demand observance by the surgeon; the action of the bowels will be arrested by position, by inactivity, and by the shock to the nervous system. This condition of temporary torpor will recover itself in the course of thirty-six or forty-eight hours, and if not, it may be assisted by the mildest form of aperients. Little medicine is required of any kind.

The period at which the splints should be first removed depends on circumstances. So long as we have ocular evidence that the length of the bone corresponds with that of the opposite limb, and that the patient has no cause of complaint from the unequal pressure of the splints, but that he lies easy in bed, and that the regularity of his functions of appetite, of sleep, &c., is resumed, we have no excuse for their removal. It is the practice of some surgeons to indulge what appears an idle curiosity, by removing the splints almost daily. There can be no warrant for this practice, so long as the parts are undisturbed, and free from pain. At least five or six days, or even a week, may be allowed to elapse before the limb is examined, when the upper splint should be carefully removed, and as carefully replaced, if all appears progressing well. If, however, the limb be again shortened, and the bones appear to overlap, the splints should be removed, and extension repeated as at first, addi-

tional care being taken in their readjustment: should the first examination prove satisfactory, the splints should not be removed for at least another week, or ten days.

It is the practice of the French school, and recommended by Dupuytren, to remove the splints on the day after the accident, in order to ascertain that the position of the bone is satisfactory, and that gangrene of the limb has not taken place. No doubt, gangrene has occurred in reported cases on the day after fracture, but that fact forms no solid grounds for the removal of the splints on the second day. The liability to gangrene may be pretty well ascertained by the degree of injury which the soft parts have sustained before putting up the limb. In cases in which extensive injury of the soft parts has occurred, it is necessary to examine the limb, not only on the day following, but on any and every subsequent day; but this occasional liability cannot, surely, subject all fractures to the same necessity.

At the same time that this reasoning appears to be just, I admit that no great evil can arise from the removal of the splints, as above recommended by Dupuytren. I merely object to the grounds on which its supposed necessity is placed.

When the limb appears contused, and indeed under almost every variety of circumstance, it is desirable to increase the tension of the straps which encircle the limb, after the first day or two; or, in other words, it is desirable to apply a moderate degree of pressure only in the first instance.

When an oblique fracture occurs in a person of irritable habit, who lies restless in bed, obeying very imperfectly the instructions of the surgeon as regards quietude, it often happens that every care bestowed fails to retain the bone in its position. Under these circumstances we are compelled to resort to some artificial mode of maintaining permanent extension of the limb; or what is preferable, the counteracting force, in the case of fractured thigh, may be enlarged by the application of a long splint, used by the late Mr. Liston,* which passes from the axilla to the foot, and is attached around the abdomen, perineum, thigh, and leg. The instrument invented by Mr. Bottomley is an improvement upon it.

Permanent extension has been occasionally resorted to, by means of a weight hanging over pulleys, but it is difficult to regulate, and

* Originally invented by Baron Boyer.

is a source of continued restraint. The object may be better attained by two, or even three, steel springs, each end of which is let into a socket, formed in a firm belt, applied at the extremities of the fractured bone. One should be applied around the thigh, immediately below the groin, and the other close above the knee; and the springs, which should be about an inch in breadth, and operating with a force of some six or eight pounds, bent, and introduced into the sockets made to receive them. This extension, which need not be very great, is permanent, and has the advantage of being unaffected by the movements of the body. It is, perhaps, hardly necessary to say that the springs should be applied during the full degree of extension of the limb.

An improvement on the spring is that of an instrument, which makes extension permanent by the tension of a strap on the principle by which we elongate an ellipse by the application of lateral pressure on its sides. By tightening the strap we increase the extending power. The plates exhibit the instrument before and during its application to a fractured thigh on the left side.

Fig. 21.

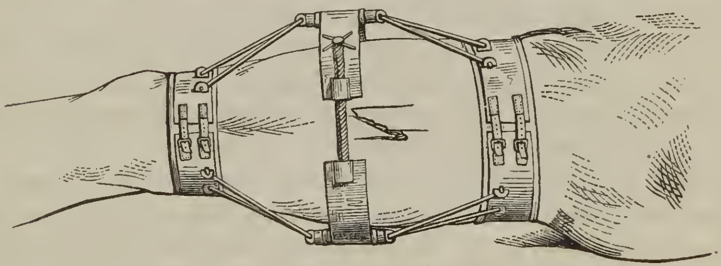
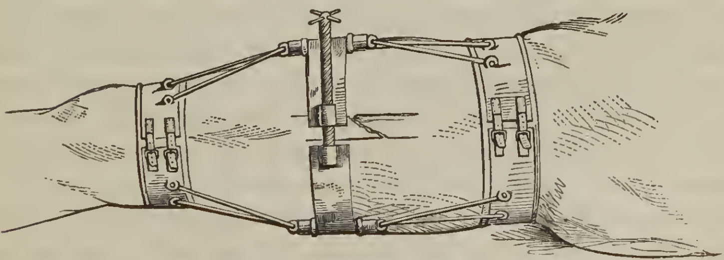


Fig. 22.



When the shortening of the bone with overlapping results from spasm of the muscles, occurring within a day or two of the acci-

dent, this principle of permanent extension is not applicable to the case. The evil must be met by constitutional treatment and careful watching.

In cases of large contusion, in which blood is extravasated, the splints should at first be loosely applied to the limb, for otherwise their pressure will be a source of mischief. If the extravasation be very great, it will be better to postpone the application of splints altogether for a few days, and either to resort to the long splints or to permanent extension by means of the instrument I have above described. This treatment is especially required in injury of the soft parts, likely to lead to disorganization. The surface may vesicate and become gangrenous, under which circumstances, of course, the presence of splints would greatly aggravate the evil.

With regard to position, much has been said by Pott and by many subsequent writers, the greater part of which resolves itself into the necessity of avoiding any undue strain on the muscles. If the leg be placed in a straight line, the flexors of the leg are in an attitude of less ease than if the thigh were a little bent; and by placing the limb in the position of semiflexion, we obviate the liability to spasm of the muscles involved. This principle is a good one, when practicable, and should be strictly observed.

The treatment of compound fractures demands all the art of the highest classed surgery, whether relating to their local or to their constitutional management. In simple fractures, the attendant evils are immediate and slight in degree; in compound fractures, the present symptoms are severe, and are yet more so in prospect. Local inflammation, extensive suppuration, and possibly gangrene, are accompanied by the various forms of severe traumatic fever, assuming the characters of hectic and typhus. In severe cases, the constitutional forces are reduced to the lowest ebb, the powers of life are exhausted, and under circumstances of peculiar difficulty, the question of amputation is often raised. This condition infers a fault in the management of the case on the part of the surgeon:—either an error in judgment at the outset, a miscalculation as regards the extent of the injury done, excess of confidence in the constitutional powers of the patient, or mismanagement of the case during the treatment. Had other treatment been adopted, the limb might have been saved, or his life not been jeopardized. But this condition is by no means necessarily a subject for self-reproach. The best judgment is fallible; the best experience but an onward step in

knowledge. It is the sacred duty of a surgeon to avoid amputation, if possible, at the time of the accident. If the injury to the soft parts be not very great; if the bone do not largely protrude, nor the skin be extensively lacerated; if the continued warmth of the limb below the fracture indicate the escape of the main artery, and the nerves be not implicated, the attempt should be made to save the limb: but, on the other hand, extensive injury to the muscles, particularly to the skin, as the natural investment of the limb, accompanied by a large protrusion of the bone, and especially if reduced vitality, indicated by loss of warmth and sensibility of the extremity below the fracture, point to injury of the vascular and nervous systems, then amputation is the best alternative to the attempt to retain the limb. There are, in the whole range of surgical practice, no cases requiring more deliberate and sound calculation than these cases of compound fracture, in which the injury is just so considerable as to raise the question of removal, without giving a definite answer to it. Having considered this subject more in detail under the head of amputation, I proceed to the treatment of compound fracture.

In compound fracture of the thigh, which I again imagine the example, we employ the interrupted splint, which is so termed because it connects the two portions of the splint sawn asunder by an arch of iron, in order to leave the wound open for treatment, and not subject to the pressure of the entire splint. The bones should be reduced by slow and careful extension, and, if necessary, adjusted by the lateral movement of the limb, described in simple fracture, and the wound be carefully brought together, and, if possible, healed by the application of plaster.

Supposing the bone to protrude through the muscles and skin, and to be so firmly fixed as to preclude the possibility of its reduction by any force of modified extension, lateral movement, &c., what is to be done? Whether to remove the protruded bone by the saw, or to enlarge the wound. If we attempt the former expedient, we not only endanger the skin, but in removing the portion which protrudes, we leave the cause untouched; for the bone may be held by the muscles within, as well as by the skin; and, indeed, in order to detach it from the skin which encircles it, the bone must be forced out yet further through the wound, and if the entire shaft of the bone be removed, we preclude the chance of recovery without permanent lameness, for the bone is shortened by so much as has been

removed. The better treatment, generally, is that of enlarging the wound with a knife, and, if necessary, the division should extend even through the offending muscles.

The question of making a wound through sound skin is essentially distinct from that of enlarging a wound already made by the addition of a clean incision, and, therefore, to that course we are necessarily driven.

The bone being reduced, the limb is to be "put up" with more than usual care, the edges of the wound carefully brought into apposition, the interrupted splint occupying the aspect of the limb on which the wound is placed, unless this aspect can be altogether avoided, and the limb placed over a slightly inclined plane, that is, raised from the groin to the knee, and then as slightly bent downwards towards the heel. The length of the part which supports the thigh should correspond with that of the thigh it supports. If too long, it will drag on the knee, and inevitably distort the lower fragment of the bone below the fracture; if too short, it will be useless. And this is the great objection to the double inclined beds, invented by my late friend Mr. Earle. Unless the bed fit the body with some approach to accuracy, the entire of the femur will not lie flat upon it, and the consequence is that the lower fragment, especially if the fracture occur in the neighborhood of the knee-joint, will ride upwards, and leave a lump or swelling, caused by the inapposition of the two surfaces. To possess the full advantages of this generally excellent invention, the pelvis should rest entirely in the hollow formed by the angle; but instead of this, the pelvis of many patients, occupying beds too short for their height, rests across the angle, instead of in it, in consequence of the leverage caused by fixing the feet to the board, the leg being the lever, and the ham the fulcrum.

The recovery from a compound fracture, in all cases of severe injury to the soft parts, is necessarily slow, for deep-seated inflammation follows, and more or less suppuration continues for many days or weeks. If the wound heal permanently, for it may unite and the edges again separate, the process of suppuration will either not form at all, or will be very limited in degree. Under such circumstances, the progress of the case towards recovery will be less tardy. If the wound do not unite, but, on the contrary, if it show marks of inflammation around it, it is obvious that the case must progress through suppurative action. Here all the powers of the constitution are required to carry the patient through the depressing in-

fluence of the disease; and then is it that we begin to feel the pernicious results of early depletion, mainly employed to prevent consequences inevitable to the great extent of injury the parts have sustained. The fever, in the first stage, assumes the character of the simple inflammatory kind, gradually changes with the change of the local symptoms to that of hectic, in which a large secretion of pus, and general relaxation of the ordinary secretions, draw rapidly on the vital powers. All this time no process of reparation has commenced in or about the bone. The period occupied in simple fracture in uniting the bone is here engaged in repairing the injury done to the soft parts, and not until this reparation is complete, or, at least, not until diseased actions have subsided, does this process commence. In proportion to the condition of tonic health of the person are the later stages manageable. To reduce the strength in the first stage of the injury, by copious venesection or by purgation, is almost sufficient to insure the occurrence of a train of subsequent symptoms, which jeopardizes the life of the individual. In my opinion, no principle can be more false, no practice more pernicious. In compound fracture, the vital powers should be sedulously nursed from the commencement, and local irritation allayed, if possible, by absolute rest, and the employment of any form of application that is soothing and agreeable, no matter what character or form it may assume.

The case is complicated, if the fracture extend into a neighboring joint, and especially so, if the joint be a large and an important one, like the knee. If the bone be at all comminuted, it cannot be expected that the joint will be saved; anchylosis is the almost certain issue. But it by no means follows, that anchylosis should be the result of a simple fracture of a bone extending into a joint, particularly if the fracture be slight. Still, under all circumstances in which this form of accident occurs, it is right that we be prepared for the possible loss of the articulation, by placing the limb in such a position as may render it hereafter most serviceable to its owner. For example, in fractures into the elbow-joint, although possibly at other times desirable, the straight position would prove a very objectionable one. We should bend the joint so as to bring the forearm at an angle of about one hundred and ten degrees with the upper arm, this being the position which experience proves as the most generally useful. In the case of a fracture of the lower end of the femur, or the head of the tibia, extending into the knee-joint,

the leg should be very slightly bent on the thigh during the treatment; and so, under all circumstances in which the structure of the joint may become disorganized, the utility of the limb should be duly considered, supposing the joint to be destroyed.

In fractures combined with dislocation, the difficulty in the treatment is greatly increased. Of the two evils, that of fracture is obviously the greater. It is quite impracticable to reduce the dislocation unless we have an entire bone to draw upon, for the extension of the muscles, even though justifiable, could never lead to the reduction of the bone; and the bone being broken, no extension from below can reach it, supposing the fracture to occupy its upper third, or even as low as its middle, nor, indeed, under any circumstances, would it be possible to apply the agents of extension with benefit. In this condition of the limb, the course to be pursued is to reduce the fracture as though unaccompanied with dislocation, and having obtained union of the bone, then to attempt reduction of the dislocation. The bone will be united, probably, at the expiration of five or six weeks, and the dislocation may be reduced, by judicious management, even to a later period. (*See* DISLOCATIONS.)

The application of a starched bandage, after union of bones, is very desirable, and, indeed, becomes necessary, should the limb be called into employment before the union is perfectly firm; and it will afford great support and a sense of security that is highly valued by any patient who is compelled by necessity to move about prematurely. The bandage should, of course, be applied when wet, with the patient at rest, in which state he should continue until the bandage, having become dry, has acquired sufficient stiffness to effect the object. White of egg, with flour or with whitening, is occasionally substituted for the starch.

The bones of young children are susceptible of being bent when the force is insufficient to produce fracture. We observe this change of form produced in the clavicle, forearm, and even in the thigh and bones of the leg. Such an effort of violence cannot be obtained without injury to the organization of the bone, and it should be treated like fracture, in the reliance on the resources of nature to replace and remodel the bone, under the influence of simple pressure.

FRACTURE OF THE LOWER JAW.

Fractures of the lower jaw may occur in the vertical or in the transverse direction, but are far more frequent in the former. They almost invariably arise from a blow, by which the bone may be broken in any part from the symphysis to the ramus. The evidence on examination is generally conclusive. The separation of the bone is for the most part slight, and is often imperceptible without manual examination. The simplest application is often the best, and as regards the inferior maxillary bone, a piece of linen three feet long, and about six to nine inches in breadth, will make an excellent bandage for the occasion, if torn from each end to within five or six inches of the middle. (*See* BANDAGES.) The centre may be cut away for the chin. Two ends are then tied behind the head, and the posterior two are carried upwards and fixed over the head. Should this fail to keep the bones in apposition, a mould of the jaw may be made in pasteboard, wetted in hot water. This mould, fixed on to the jaw, will harden in a few hours, and should be retained by the above bandage. Sometimes it is necessary, in vertical fracture, to tie two or more teeth together with a silk thread. The vertical fracture requires the application of the agents of retention, whatever they may be, for an average of twenty-five to thirty days. If transverse, somewhat longer.

FRACTURE OF THE RIBS.

Fracture of the ribs is the result of a blow directed against the chest. If by a pointed instrument, a single rib will be broken; if by an obtuse force, probably two, or more. Whatever be the form of the immediate agent of the injury, the force must be applied suddenly, or the elastic support of the rib would protect it, at least from fracture.

A rib is usually broken at, or near its angle, that is, about three or four inches from its attachment to the spine, because it is here that the two forces, viz., that of the blow and that of recoil meet, although the blow may have been received at some distance forwards. This part of the rib being covered with large muscles, explains the difficulty which so frequently attends the detection of the injury. The symptoms by which it is ascertained are local pain

on pressure over the suspected region, and crepitus. But this latter symptom cannot be perceived without a force of pressure that is exceedingly painful, so much so, indeed, as often to preclude any prolonged examination.

A broken rib is brought into coaptation on the same principle on which other fractures are reduced, viz., by extension. This object is attained by making a full inspiration, and by distending the lung to its largest dimensions. By this means the extremities of the rib are elongated, and the fractured ends are brought into apposition. This relation should be maintained by means of an elastic bandage applied around the chest, which, while it retains the bones in contact, permits, at the same time, a freedom of respiration which is rendered difficult, and indeed impossible, under the agency of common calico or flannel. A rib will usually unite in from twenty to twenty-five days.

FRACTURE OF THE CLAVICLE.

This fracture is generally caused by a point-blank fall on the shoulder, by which the collar-bone is either fractured or dislocated. It is, however, a far more frequent accident than dislocation, which is very rare. The symptoms are generally distinct and unequivocal. 1. The line of the bone is interrupted, the inner portion being raised. This irregularity is ascertained by passing the hand along it. 2. The head is often drawn a little to the affected side, to relax the sterno-mastoid muscle. 3. The shoulder, having lost the radius of its movements, approaches the mesial line of the body, compressing the axillary cavity. 4. None of the muscles attached to the bone can be brought into full action. Displacement, however, is not the invariable attendant on fracture of the collar-bone. When the fracture occurs at the distance of about an inch from the acromial end, or between the two portions of the coraco-clavicular ligaments, these ligaments, acting on the bone above, prevent their separation, and fracture is then detected with more than usual difficulty. I have frequently known fracture of this bone to occur in young infants.

The treatment of fracture of the clavicle involves extension of the bone, and adjustment of the broken ends. This is effected, as in dislocation, by drawing the shoulders backwards, while the knee is applied against the middle of the back, and retaining them by the figure of 8, or Brasdor's bandage. Care should be taken to protect

the axilla by pads, which, with the bandage, will require reapplication nearly every day. A large pad should be put into the axilla, if there be any tendency in the bones to overlap. A month will be required for the union of the bone.

FRACTURE OF THE SCAPULA.

Fracture of the body of the scapula is exceedingly rare, consequent on the mobility of the bone on the trunk, to which it is connected by little more than muscle. A severe blow on the bone, by which it is struck against the ribs, may, however, break it in any direction, whether vertically, obliquely, or transversely. The acromion process may be fractured distinctly from the rest of the bone. The neck of the bone may be partially or entirely separated from the body, and the coracoid process may also be broken singly; but all these fractures are rare. If crepitus be not perceptible, the knowledge of fracture may be obtained by negative evidence. If the clavicle be sound, and the line of the acromion be uninterrupted, if the head of the humerus rotate without pain, *when extended or drawn from the socket*, if the forearm be bent without difficulty, or without the expression of suffering, and crepitus be still felt, the body of the bone must be broken.

Fracture of the coracoid process is an exceedingly rare accident. Pressure in the situation of this process, between the deltoid and pectoralis muscle, will detect it; and this evidence will derive confirmation from the painful action of the muscles arising from this process, viz., the pectoralis minor, coraco-brachialis, and biceps. If the pressure of the finger give no pain, and the biceps muscle can be put into action by bending the forearm, the coracoid process cannot be broken.

With regard to the neck of the scapula, the portion so called would include the glenoid cavity and coracoid process as far as the notch. But a fracture of this extent is also very uncommon, although fracture of the neck of the scapula, like that of the coracoid process, is spoken of as of frequent occurrence; but I am persuaded it is far otherwise. Fracture of the glenoid cavity, however, is not so rare. It is detected rather by negative than by positive evidence, but that evidence is generally very conclusive. A severe blow or fall on the shoulder is followed by distinct crepitus. The surgeon passes his finger along the collar-bone and acromion, extending to the spine;

the patient bears pressure without flinching. The coracoid process is subjected to the same inquiry. There is no evidence of fracture. The head of the humerus rotates under the hand without pain, while hanging at the side, or when the attempt be made during extension from the side. Nothing remains but the glenoid cavity and the neck, by which term I now refer to that above described, although the term is often applied to the connecting material, which unites the glenoid cavity to the body of the scapula. If the whole angle be broken, including the coracoid process, its extent would render it at once obvious; it is probable, therefore, and almost certain, that the glenoid cavity itself, or, what is more likely, that a part of it has separated. If, in the act of rotating the arm, the head of the bone be pressed somewhat firmly against the glenoid cavity, then a partial crepitus is felt, that expresses a fracture of a portion of that cavity only.

In all these forms of injury, the arm should be well supported at the shoulder by a well-adjusted sling, and the shoulder and arm bound to the trunk by a roller, or by that complicated appendage of the arm to the trunk, called Desault's bandage.

FRACTURES OF THE HUMERUS.

There is no peculiarity in the fracture of the shaft of the humerus, requiring particular observation or treatment, beyond the application of general principles. The upper end generally "rides" forwards or upwards. This position is due to the action of the deltoid muscle, and it must be met by a corresponding elevation of the lower portion, or fragment. Three splints will suffice, if that which is placed behind is made to curve in the transverse direction, by being split longitudinally, and glued to thin leather. If four splints be used, care must be taken that they do not overlap. The upper arm, in very muscular subjects, is difficult to manage in fracture, on account of its rotundity rendering it unsuited to the application of splints. Full extension should be made before the splints are applied in the first instance. This should be effected in the semiflexed position of the forearm, by which means we neutralize the actions both of the biceps and brachialis anticus muscles; and this position should be retained throughout the treatment, for by it we gain more in the approach to a suitable and soft substance for the reception of the anterior splint, by the relaxed condition of the biceps in front, than

we lose by the slight degree of extension permanently made on the triceps behind.

Fractures of the neck and head of the humerus are often difficult of management. Fracture of the neck is occasionally complicated with laceration of the deltoid muscle, in the fibres of which the lower fragment becomes entangled, and from which it is exceedingly difficult to detach it. This fracture may be ascertained by placing the hand as nearly in contact with the head of the bone in the axilla as possible, and rotating the shaft. It is then obvious that the head does not move freely with it, and crepitus is very distinct. This fracture may be distinguished from that of the glenoid cavity by the crepitus being larger and more distinct, and by its presence in rotation during moderate extension of the arm from the shoulder-joint; whereas fracture of the glenoid cavity is only apparent in rotation of the arm, when the head of the humerus is pressed against its socket in the scapula. In fracture of the humerus, also, the head of the bone does not revolve with the shaft in forced rotation; and the attempt to rotate creates pain.

After reduction of the bone by extension, a well-made pad of large size should be introduced into the axilla, against which the chief, and indeed the only practicable splint should rest; and it must be so firmly applied to the lower surface of the arm as to maintain permanent extension. The arm should be raised considerably from the side, and supported over a soft pillow, the patient himself being placed as nearly in a sitting posture as possible, in order to insure permanent extension, by the addition of the weight of the limb to that obtained by the splint already applied. When these and similar measures fail, the arm should be kept at rest over the pillow; and we must trust to the curative powers of nature to restore it to utility, which she rarely fails in a great degree to do. In the cases in which the lower part of the shaft is lodged within the fibres of the deltoid, the attempt to disengage it should be made by every reasonable means, such as rotation, pressure, elevation of the arm to its highest position, accompanied by renewed pressure on the projecting end of the bone. If these several means fail in accomplishing the desired object, the case must, with such slight assistance from art as we can afford, be left to nature for its restoration; and we may rely on it that our confidence will not be misplaced, if our expectation be not carried too high.

Fracture of the humerus at its lower end is liable to be mistaken

for dislocation of both bones of the forearm backwards. This remark has been made by Dupuytren, who considers this error in diagnosis a frequent one; indeed, he says, "there is nothing so common." I cannot admit the truth of the opinion, however exalted may have been the reputation of Baron Dupuytren in the French school of surgery; or perhaps I have been unfortunate in not having witnessed the examples given. I consider, from the tenor of the evidence, that the cases in question were really examples of dislocation of both bones backwards, but accompanied with fracture of one or other, or possibly of both condyles of the humerus. But it is inconceivable that any number of men, possessing even a moderate share of surgical knowledge, should habitually mistake a fracture for so comparatively simple an injury as a dislocation backwards. Still, fracture of the lower end of the humerus may be, though not commonly, mistaken for dislocation of both bones backwards, particularly when the swelling is considerable immediately after the accident. The evidence appealed to by Dupuytren, and derived from the gradual lapse of the bones when reduced to their abnormal relations, is by no means conclusive of fracture of the humerus, because the same displacement is most liable to occur in dislocation of the ulna backwards, with fracture of the coronoid process of that bone.

These cases, when reduced, may be often treated by position alone, as adopted by Dupuytren. At all events, it would be well to try the experiment; and for this purpose the patient should be placed high in bed, as nearly in the sitting posture as possible, and the arm raised at the side of the body, inclining over a soft pillow, into which it should be sunk. Should this measure fail by reason of the contraction of the muscles and the unsteadiness of the limb, the apparatus I have described in the introductory remarks on fracture, for making permanent extension, should be applied without splints, which then become unnecessary.

FRACTURE OF THE FOREARM.

One or both bones may be broken. The evidence of fractured radius is often detected with difficulty, partly in consequence of its complete investment by muscle, partly because overlapping is prevented by the ulna, which retains its natural position, and partly on account of the great natural mobility of the bone, which renders

it difficult to fix the upper end while the lower is rotated. In all such cases of doubt, it is better to apply two lateral splints, as though the bone were broken, and to place the arm in the semiprone position. Whenever it is necessary to apply splints to the forearm for fracture, their influence should extend to the extremity of the hand.

The bones of the forearm are liable to be broken immediately above the carpal joint. This fracture is usually made obliquely through the radius from behind, downwards and forwards. The ulna may or may not be involved. This form of fracture is supposed by Dupuytren to be frequently mistaken for dislocation of the hand and carpus backwards. I have elsewhere quoted his opinion, which declares the dislocation in question to be an accident unknown to his experience. He considers them to be fractures of the bones of the forearm invariably. One important sign distinguishing fracture from dislocation is its liability to displacement after reduction. I have seen examples of injury at the wrist joint in which this evidence was conclusive in favor of dislocation, and I cannot but distrust the opinion expressed by Dupuytren in such strong and unequivocal terms. In dislocation of the carpus backwards, the anterior edge of the radius may be felt to occupy its normal position, and the styloid process of that bone is placed longitudinally, and continuously with the shaft. In fracture, the styloid process is not only displaced by being driven upwards and backwards, but it lies obliquely with respect to the shaft of the bone. But all simple cases, whether of fracture or of dislocation, recover under judicious treatment. In either case, the arm may be drawn into form, and the bones reduced, whether separation has taken place at the carpal articulation or through the body of the radius and ulna. If the extension required be considerable before reduction, it would form an additional argument in favor of dislocation. In both examples of injury, the styloid processes of both radius and ulna form our best guide. Two splints, well padded, should be applied, extending to a length sufficient to include the hand, which ought to be well supported in the semiprone position, and the hand forced a little backwards by a large and thick pad corresponding with the palm. Great care should be taken to prevent the hand falling, and this object will be attained by inclosing the entire forearm and hand in a well-applied sling.

FRACTURE OF THE PELVIS.

Fractures of the pelvis may occur in almost any part. Perhaps the most common locality is that vertically, through the obturator foramen, including the transverse ramus of the pubes, and the vertical ramus of the ischium, or pubes. It may be fractured vertically, through the acetabulum, or more posteriorly through the ilium, or separation may take place at the side of the symphysis pubis, or at the sacro-iliac symphysis. This serious injury is always the result of great violence, such as a fall from a height. More or less displacement may take place, but the separation of the fractured bones is rarely great, consequent on the integrity of the opposite half of the pelvis. In many cases, therefore, the symptoms are very obscure, particularly if the broken bones remain in contact, and the attention of the surgeon is probably directed to some other ailment or injury the patient may have sustained at the same time. The knowledge of the full effect of the violence sustained may not be acquired till the following day. In the mean time the patient finds himself unable to move or to turn in bed without pain, and is himself conscious of the presence of crepitus in every attempt to do so. In other examples the fracture is palpable from the commencement; but in such, the injured pelvis is the chief and primary object of interest to the surgeon. If separation has taken place, every movement of the body is painful, and spasm of the muscles is often very severe, probably caused by rupture of some fibres of the muscles attached to it. This is the case more especially in fracture through the ilium, involving the iliacus internus, and possibly the gluteus minimus, or, what is not improbable, the edge of the bone may have punctured the muscles, and hence the spasm and the very severe pain that attend some examples of this injury.

The treatment consists in binding up the pelvis with a circular bandage. If the material be elastic, it will exert a more steady and uniform pressure, and the relief afforded by such means is immediate and great; all pain and spasm often subside directly on its application. I attended a lady with separation at the two symphyses of the pelvis, after labor. She was quite unable to move for months. I had a strong leather case made for her pelvis, the degree of pressure of which she could regulate at will, by the aid of which she perfectly recovered, and subsequently bore a child, without the least

symptom of her former malady. Occasionally, even under good observation, a case of fractured pelvis may escape detection, to be discovered only after death.

FRACTURE OF THE THIGH BONE.

As in the case of the humerus, the chief interest of fracture of the thigh relates to the extremities of the bone; viz., fracture of the neck, or of the shaft immediately below it, and that of the condyles, singly or both. Much has been both written and said on fracture of the neck of the thigh bone, but unhappily nothing very profitable for the subjects of this serious accident has emanated from the lengthened controversy that engaged the surgical world. It is, however, notorious, that the neck of the thigh bone does not commonly unite after fracture, and especially so when the fracture occurs close to the head; and it is equally notorious that the neck of the thigh bone may, and often does, unite after fracture, under circumstances favorable for union. The old ground of want of vitality from physical conformation, to which the infrequency of union was referred, is now abandoned, and the fact is more reasonably attributed to the difficulty of keeping the broken bones in close apposition, and to the want of constitutional power in those more especially liable to the accident.

The symptoms of *fracture of the neck of the thigh bone* are very conclusive, if ascertained by deliberate inquiry and examination. A surgeon whose opportunities of acquiring experience on such accidents are not very great, should refresh his mind by reference to written works, or to the authority of others, before determining the nature of the case, and the treatment he will adopt. To mistake a fracture for a dislocation is not a very uncommon error among those who witness these examples of injury but rarely, nor perhaps is it very surprising.

Three times, within the last two years, I have been sent for, and on one occasion to a distance, and during the night, to supposed cases of dislocated femur. Each case proved to be a fracture, and as such was visible, as the patient lay on his bed, without any inquiry beyond that obtained by a single glance. I was called one night to the east end of London to a supposed case of dislocation of the thigh. I entered the room of the patient in time to hear the exclamation from one of the parties engaged in "lending the high resources of

our art to the mitigation of human suffering," "*It's out again!*" On this case, three members of our profession were engaged in the endeavor to complete the task of reduction. The attempt, no doubt judiciously applied, failed, simply because there was no head to reduce, and no socket to receive it. It was palpably a case of fracture of the neck of the bone. No benefit could have arisen from an unnecessary revelation of the nature of the injury to the patient or her friends, and I therefore told her that the attempt to replace the bone had been partially successful, and that we would not subject her to a repetition of an extension that appeared so disagreeable. On another occasion, I was called out of town to a case of dislocation of the femur. I ventured to catechize the gentleman who came to my house on the subject of the injury. I inquired, "Is the foot inverted?" "Yes," was the answer. "Is there a positive swelling on the hip?" "Yes." "Is the limb shortened?" "Yes." I took my pulleys, and accompanied my colleague. It proved to be a case of fracture—the limb everted, and the foot, of course, turned out!

The *symptoms* of fracture of the neck of the thigh bone are,—first, shortening of the limb; secondly, eversion of the foot, with that of the rest of the limb, and loss of the trochanter major: thirdly, rotation made without effort, especially inwards; fourthly, crepitus, distinct of its kind, when the limb is rotated after extension, by which the two broken surfaces are brought into apposition; fifthly, the great frequency of the accident in old age; sixthly, the sense of great injury sustained, and the greater severity of the symptoms of fracture, when compared with dislocation of the same bone; seventhly, in fracture, extension of the limb to the natural length is followed by renewed retraction. We often have ecchymosis also in fracture, which I have never seen in simple dislocation. The crepitus is unlike that caused by the friction of hard bones against each other. It is softer and more crackling, as though the two surfaces were not fully in contact, but caught against each other by loose fragments. In fracture there is often experienced considerable pain on pressure made on the groin.

These symptoms are generally attendant on all cases, but not invariably; and in some, indeed, we observe a remarkable deviation from them. For example, cases are recorded of inversion of the foot and leg, instead of eversion. Desault alluded to it. Mr.

Guthrie* has described such an example, as also has Mr. Stanley; and Mr. Savory has met with a recent example; but they are exceedingly rare. A more striking exception to the above symptoms is occasionally found in their almost entire absence, of which I have myself seen two examples.

The first occurred in the person of an old lady of seventy years of age, who slipped in the act of moving from her bed to a couch. The fall could not have been more than nine inches. In this movement she broke her radius above the wrist. I examined generally all her limbs; but the fractured arm appeared to me sufficient to explain her discomfort, and she was not conscious of further injury. I remember well, however, to have observed her to raise her two lower limbs without pain or difficulty. I saw her for some days, and then discontinued my attendance. Two months afterwards, I was sent for to see her, and found her with marked symptoms of fracture of the neck of the thigh bone. She had shortening to the extent of two inches, and complete eversion of the foot. On drawing the limb downwards, it immediately retracted to its former position. She had not moved from bed since I had last seen her. In a second case, which was brought into St. Bartholomew's Hospital, a man had partial eversion of the foot, with crepitus, sufficient to substantiate a fracture, and in the situation of the neck, as it appeared to me. In three weeks the retraction and eversion were complete, and the case no longer admitted of a doubt. The cause of this injury was a fall from the last step of a ladder on to the ground, and the man was middle-aged.

The solution of these cases appears to me to be the slight amount of violence by which the injury is sustained, and which, indeed, is not sufficient to cause separation of the ends of the broken bone. Slight motion at a future time may influence their relations, and the muscles then exert the power of gradual displacement, and hence shortening and almost necessary eversion.

In addition to the ordinary fracture of the neck of the bone, a further injury may be sustained by the upper end of the broken bone being driven into a split portion of the trochanter major and shaft, or generally of the shaft only. The part is generally so wedged in, as to preclude its extraction by any force that can be applied to it. The trochanter is partly forced asunder, but still continues promi-

* Med.-Chir. Trans., vol. xiii.

nent. There is no crepitus, and no retraction.—I know of no treatment that can be serviceable, beyond rest.

Fractures below the trochanter are less common than fractures of the neck of the bone. The mass of muscles that here surround the bone render the crepitus often indistinct, and the shortening is absent altogether in transverse fracture. If the fracture be oblique, the upper end projects forwards.

The mode by which permanent extension is made is by the employment of the long splint, on the principle of that recommended by the late Mr. Liston. Still, I am inclined to think, when we look at the bony fabric of the pelvis, which will bear pressure to a great extent, without injury to the functions either of the abdomen or pelvis, that a firm, and broad, and well-padded leather, or even metallic band, might be so applied around it as to admit of the upper end of a long splint being let into a socket formed on the affected side. This would leave both the chest and the abdomen disengaged, and answer every requisite purpose of permanent extension. The form of permanent extension proposed by the double-inclined bed, invented by the late Mr. Earle, is, for reasons I have already given, for the most part objectionable. I can readily believe that this useful agent, both of comfort and of cleanliness, might be profitably employed in the treatment of fractures of the neck, or of the shaft of the thigh bone; but the objection lies in the disparity of length of the person and of the bed, and the extension generally fails. When of a length suitable to that of the body resting upon it, its application is excellent. For the application of an agent that will effect a continued extension on the thigh, in cases of oblique fracture of the shaft, with shortening, I prefer the apparatus I have described to the long splint, as less inconvenient and more efficient.

During the attendance of Mr. Abernethy on St. Bartholomew's Hospital, his custom was to place all patients with fractured thigh on the side, according to the practice of Mr. Pott, bending the thigh on the pelvis, and the leg on the thigh, and I cannot say that I find the practice of the present day more successful than his.

The femur may be fractured above the condyles, or across these large processes, into the knee-joint. The injury is detected without much difficulty. *In fracture across the shaft, immediately above the condyles*, the lower end may ride forwards, or fall below the level of the upper portion. In either case, it should be reduced, if possible, to its position, by judiciously made extension. Sir Astley Cooper

recommended the knee to be bent, and placed over an inclined plane. But the desirableness of this position would something depend on whether the bones were thoroughly reduced to their respective surfaces or not. If the attempt to do so were successful, I can see no objection to the straight position; but, on the contrary, should deem it a desirable one, as more likely to ensure the entire apposition of the two portions of bone. When I say the straight position, it should be understood in reference to all affections of the knee-joint; that a position which is absolutely straight is by no means necessarily an easy one; but that, under all circumstances, the rest of the joint is consulted by the addition of a pad placed in the ham, which will produce the slightest bend to the joint. To force the limb into a straight posture, without giving the requisite support to the back of the knee-joint, is to compel a position that will, if not at first, shortly become irksome, and even painful.

Fractures through one or both condyles almost necessarily extend into the joint. Under these circumstances, it is highly probable, though by no means essential, that anchylosis will follow. It is, however, far more likely that it will; and this likelihood is due to the violence done to the structure of the articulation, in addition to that sustained by the bone and soft parts around. With respect to the joint itself, the cartilage, with the synovial membrane, is almost certainly ruptured; spiculæ of bone may project into the cavity; the fissure may remain open, and the medullary fluid escape into the joint. All this leads to inflammation of no mild character or degree. The joint becomes distended; pain of many days' or of some weeks' duration follows, that no depletion will relieve; the cartilage is absorbed, and the joint destroyed. To meet this probable result, the limb should be placed in such a position as will ensure its future utility, which is that of slight flexion. It should be divested of bandages. Sir Astley Cooper recommends that it be laid in a cradle of pasteboard, moistened to fit it. Certain it is, that splints and severe restraint are useless. The joint should be laid over a pillow, well supported at the ham, and the knee be slightly bent.

FRACTURES OF THE PATELLA.

Fractures of the patella owe their origin much more frequently to the action of the extensor muscles, which are inserted into them, than to external violence. This fact is established in general belief,

however incredible it may appear; and it *is* almost incredible that any power of muscular contraction, however great, could be so applied upon a short thick bone, like the patella, as to tear it into two parts. It would be difficult, if not impossible, for such a separation to be effected by art. Yet the evidence that the bone is severed without even the proximity of violence, is most conclusive, and that consequent on the injury the patient falls to the ground. The fracture may take place in any part of the transverse axis of the bone, either near the insertion of the muscle above, or near the attachment of the tendon below, or across the middle. As regards the question of entire recovery, much depends on the degree of retraction of the upper portion of the bone which may be drawn upwards from the distance of half an inch to that of four inches or more. I have seen the bone drawn by the rectus muscle considerably higher than the attachment of the lower fibres of the vasti could be supposed to permit its retraction. No less remarkable is the fact of a second fracture of this bone, occasionally occurring at an interval of time between the old line of union and the insertion of the muscles above. I have seen two well-marked cases of injury under the care of Mr. Stanley, in St. Bartholomew's Hospital. In one of these cases, the retraction, after the second accident, was considerable. Judging by the close approximation of the former line of junction, the first separation must have been much less considerable. The degree of elevation or retraction of the upper end is not the immediate result of the accident; but it continues increasing for some days after the injury, unless prevented by mechanical means. These cases are very difficult of management when the retraction is great. The portion of bone is so small, and the offending muscle so powerful, that we can, in reality, exercise little influence on the bone, our efforts being almost entirely limited to the endeavor to obtain relaxation of the rectus muscle. For this purpose, the thigh is raised considerably on the pelvis, and the leg placed in a straight line of extension on the thigh. By this means the rectus muscle is as much relaxed as possible; and it owes its relaxation not only to the straight position of the leg, but to the bent position of the thigh on the pelvis—what in anatomical language is termed *extension*;—for the action of this muscle influences the position not only of the leg, but of the thigh. It is an error, not merely common, but almost universal, to attribute the flexion of the thigh on the pelvis to the psoas and iliacus muscles, which have really no influence whatever in

raising the leg, as I have proved by experiment to my own satisfaction and to that of others. This action of the limb is effected entirely by the rectus femoris, else whence the benefit of raising the thigh on the pelvis in fractured patella? If the rectus do not influence the position of the thigh, why not place the limb, in fractured patella, in the horizontal position, by which the extension of the knee can be as fully obtained as in the elevated posture of the limb, usually adopted? It would appear that we had instinctively adopted the position most consistent with the entire relaxation of the rectus, although, according to general opinion on the action of this muscle, no advantage ought to be obtained by affecting the relations of the thigh on the pelvis.

It is very desirable to treat a case of fractured patella as early as possible after the accident, with a view to prevent a greater degree of retraction than has already taken place. As we can exercise no direct influence on the bone itself, all our care and attention are directed to conciliating the retracting muscles; and for this purpose the thigh should be gently rubbed from above downwards, beginning near the groin. I am inclined to think that the best position in which this operation can be performed on the patient will be that of sitting upright in bed, or even that of bending forwards over the extended thigh and leg. In this attitude, the skin is altogether more relaxed than in the elevated position of the limb. The thigh should be rubbed and kneaded by the hand, and the muscle gently compressed from above downwards, till it shows a disposition to relax. Should this process, persevered in for an hour or more, fail to effect relaxation of the rectus, chloroform should be administered, and the process renewed under its influence. As the muscle relaxes, pressure upon it should be adopted by means of a roller applied around the limb, from the groin downwards, to somewhat below the middle of the thigh. The objection to carrying the pressure too low on the joint, particularly if much effusion has taken place into the cavity, is obvious; but there is one especial reason against it, viz., that compression of the upper half of the bone, or even of the tendon inserted into it, would have a tendency to tilt up the broken surface, and present an edge, instead of a surface, to the lower half. Should these means fail to bring the two portions of bone into proximity, it is better to place the patient altogether in the sitting posture in bed, and to leave the thigh entirely open and free from restraint, when, in all probability, the muscle will gradually relax to its fullest

degree. Little can be done with the lower portion, but that little may be accomplished by the pressure of a good-sized pad of lint, fixed by a broad strip of plaster, applied obliquely upwards on the sides of the joints. As a general rule, union by ligament, as it is termed, is attended by difficulty in progression; but this rule is not universal. I have seen a case of fractured patella in which the permanent separation was, at least, one inch and a half, in which the walk was as perfect as in another man.

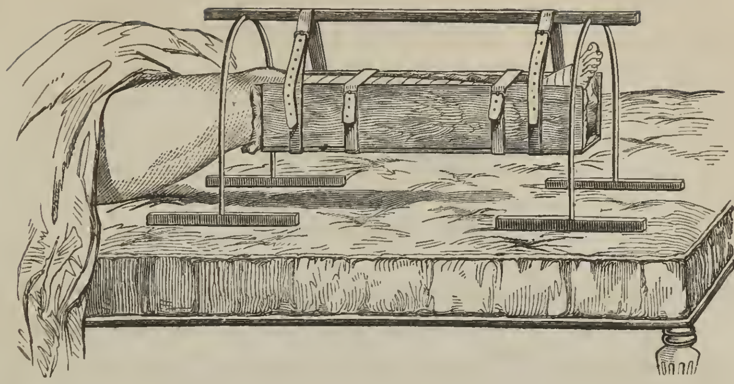
FRACTURE OF THE LEG.

In simple fracture of either bone of the leg, singly, there can be but little displacement, and there is nothing to interfere with the onward progress of the case towards recovery. Supposing the bones to be well adjusted, it is of little importance in what position the limb be placed, whether on the back or on the side. Till within the last few years the side position was universal in London. This position is now almost as universally abandoned for that on the calf. When the leg is laid between two splints, on the side, the union of the fracture is somewhat more liable to be imperfect than in the straight position on the calf. This liability arises from the want of care in maintaining the suitable, indeed the necessary, attitude of the entire body, which should be inclined fully over towards the injured side. If the patient be permitted to lie on his back, the consequence will be that the knee will rise off the bed, *and the toes will fall outwards.* Thus the union will tend to evert the foot, and produce an unsightly form, when he resumes the upright position. In order to take entire advantage of the side position, the two anterior spines of the ilia should be perpendicular to each other, and the toes should be raised. The leg inclosed in its splints should be bent nearly at a right angle with the thigh, and placed obliquely across the bed.

When the fibula alone is broken, it will rarely call for the application of splints. When severely broken, in dislocation of the foot outwards, splints are requisite, but it is of little importance whether the limb be placed on the back or on the side. A mode has been recently adopted of rendering the leg in fracture in some degree independent of the bed on which the patient lies, by swinging it in a cradle suspended by straps.

By the employment of the cradle some degree of general move-

Fig. 23.



ment is permitted to the leg, without affecting the relations of the broken bone to each other. The position of the limb is remarkably easy and comfortable, judging from the report of patients who have employed it.

CHAPTER VI.

ON ANEURISM.

KNOWLEDGE OF THE SUBJECT OF THE FIRST IMPORTANCE.—STRUCTURE AND FUNCTIONS OF AN ARTERY.—DISEASES.—NATURE AND VARIETIES OF ANEURISM.—SYMPTOMS OF ANEURISM.—PRINCIPLE OF TREATMENT.—OBLITERATION BY LIGATURE ABOVE THE SAC.—OBLITERATION BY PRESSURE.—OPERATION.—OBLITERATION BY LIGATURE BELOW THE SAC, OR BRASDOR'S OPERATION.—CONSTITUTIONAL SYMPTOMS CONSEQUENT ON TYING LARGE ARTERIES.—OPERATIONS ON WOUNDED ARTERIES.—HEMORRHAGE.—ANATOMICAL KNOWLEDGE INDISPENSABLE.—PRINCIPLE OF TREATMENT.—HEMORRHAGE FROM SMALL VESSELS.—AMPUTATION.—TYING OF ARTERIES DIVIDED IN WOUNDS AND AMPUTATIONS.—APPLICATION OF LIGATURES TO SPECIAL ARTERIES, AND THE DISEASES REQUIRING THEM.—ANATOMY AND OPERATION.—ERECTILE TUMORS AND NÆVI MATERNI.

ON OPERATIONS FOR ANEURISM, AND FOR TYING WOUNDED OR DIVIDED ARTERIES.

There is not, in the whole range of operative surgery, any description of disease the treatment of which by operation demands a more intimate knowledge of the anatomy of the human body than this. Here the most difficult and the most responsible duties of the surgeon are occasionally called into instant requisition, without time for study or preparation of any kind. The importance of the arterial system in the economy, its liability to disease and to injury, and the relations of the individual vessels to other structures around, all attach to it the greatest interest in the eye of the surgeon.

When an artery is divided, blood pours from the wound with a force proportioned to the size of the vessel and to that of the opening in it. If the artery be a large one, and the bleeding be not arrested, death will inevitably follow. This liability, however, is necessarily diminished with the reduced size of the vessel; for, as all arteries have a tendency to contract in proportion as the action of the heart

is reduced in force, so the hemorrhage from all the smaller arterial tubes ceases spontaneously, by reason of the gradual collapse of the coats of the vessel, which is finally reduced to the condition of a solid cord, as far as the first considerable branch above it.

Hemorrhage from a bleeding artery may, however, cease spontaneously by the occurrence of syncope, by which the action of the heart is temporarily suspended, or nearly so, and time allowed to the artery to contract, or it may cease from coagulation of the blood within and around the vessel. When an artery is cut across, the two inner coats both contract and retract within the vessel, and this condition may also present an obstacle to the further escape of blood from the cavity of the vessel.

The liability of an artery to bleed depends much on the extent and form of the wound made in its coats. A longitudinal wound will bleed less freely than a transverse or an oblique one, because in the latter forms of wound the coats contract and the orifice gapes widely. Also, it is notorious that a marked difference prevails in the quantity of blood which escapes from an artery cut across, and an artery suddenly rent asunder, whether by laceration or by a gunshot wound. Under either of these latter circumstances, it would appear that the two internal coats contract instantly, and prevent the escape of even the smallest quantity of blood.

The division of the arterial system into branches of diminishing magnitude would not be altogether useless. In speaking of primary branches, we should include those of the largest size, such as the innominata, the carotids, the iliacs, and the femoral and profunda, the subclavian, and brachial; of secondary branches, the branches of the carotids, vertebral, mammary, radial, and ulnar, the tibial and peroneal, &c.; of tertiary branches, the thoracic, the branches of the brachial, the digital, and pedal vessels.

Wounds, even of the secondary branches, can never be left with safety, although hemorrhage from a wound in their coats may temporarily cease.

Ligatures are applied around arteries under four conditions: first, when an artery is exposed by the knife for the cure of aneurisms; secondly, when an artery is wounded in common with other soft parts around, as in punctured or lacerated wounds; thirdly, when it is entirely divided in an amputation; and, fourthly, when an artery is tied for the purpose of cutting off the supply of blood to a part, as in nævi or bronchocele. In nearly all these forms of injury to

the vessel, a different process is adopted. In the first, we apply the ligature around a healthy artery in a sound condition, and uninterrupted in its course; in the second, having exposed a wound in the artery, we apply a ligature both above and below it; in the third, we tie up its open mouth; while the principle of the fourth is identical with the first.

We are indebted to Haller for the first and best description of the structure of these vessels. From him we learn that an artery is composed of three coats, the external of which is cellular, filamentous, and elastic; indeed, it is often identified with the cellular tissue of its own sheath, which is imperceptibly lost upon it. To this coat the artery owes its firmness and its potency when cut asunder. The middle coat, which is fibrous, has been the object of much investigation since the period of Haller. It is now deemed to be composed of muscular fibre, arranged circularly around the vessel, but intermixed with elastic tissue, the proportion of the muscular and the elastic tissue varying as the arteries reach the remote parts of the body, in which the latter is gradually reduced in quantity and gives place to the contractile action of a muscular coat. The inner coat is a delicate serous membrane, continuous with the lining membrane of the heart. Each of these coats is connected to that contiguous to it by vessels, by which the coats themselves are supplied with blood, and also by cellular tissue. The minute vessels are called the vasa vasorum, and are derived from the external sheath of the vessel and from the cellular tissue around.

When a ligature is applied tightly around either a primary or a secondary branch of the arterial trunk, the two internal coats are cut asunder, evidenced by a deep groove observed in the interior of the vessel. The sensation caused by the division is very perceptible to the hand of the operator. The necessity for this division of the two internal coats has been strongly insisted on by the British school of surgery since the publication of Dr. Jones' work in 1805, and by many continental surgeons of reputation. The principle laid down by Dr. Jones, and deduced from his interesting experiments, is that the union of the opposite sides of an artery is effected by the lymph thrown out from the vessels in the coats so divided, both within the tube of the artery and between the coats themselves, and that this lymph becomes accessory to the consolidation, and to the final obliteration of the vessel. This doctrine is denied by Scarpa, its original opponent, who asserts that apposition alone will ensure

perfect adhesion of the opposite surfaces; that the artery does not become obliterated by the organization of lymph thrown out by the divided tissues along the circle of the ligature, and in its immediate neighborhood, but by a process of adhesive inflammation uniting the opposing surfaces of the serous coat.

Two different kinds of ligature, as might be supposed, are employed by the advocates of these respective authorities ; the surgeons of this country, with few exceptions, employing a fine silk or flax thread, sufficiently small to be consistent with strength, while those of Italy and France resort to a flat ribbon-like ligature, to which they add a small roll of linen, or some firmer substance, inclosed within it, and tied on to the coats of the vessel, according to the practice of the surgeons of the last century, by whom it was invariably adopted as a precautionary measure. Such is the practice of the present school of surgery in France. I can myself testify to its being the standard practice of France, as late as the year 1822, when I witnessed its adoption, on more than one occasion, by my friend M. Béclard, and also by Dupuytren.

The value of the deductions of either of these eminent men can best be tested by an impartial regard to the deductions of the other. Both appear to be conclusive of the fact, not of the reasoning ; and it is impossible to say what would have been the general practice in this country had Scarpa and Jones spoken the same language. The opinion of Scarpa declares the necessity of a more general apposition of the opposite surfaces of the artery, and that it is unsafe to rely on the simpler contact recommended by his opponent. Dr. Jones, on the other hand, proves the complete obliteration of a vessel, by bringing into contact a narrow ring only of the artery, a principle which has been strongly supported by the advocacy of Mr. Hodgson, in his valuable work on "Diseases of the Arteries and Veins." That union of the opposite surfaces is not indispensable to the successful issue of the case, is rendered obvious, by the fact of these surfaces being kept asunder, in Dr. Jones's operation, by the coagulum which is formed in the tube of the artery.

The general inference to be derived from the consideration of the two modes of treatment is that, so far as relates to safety, one has little advantage over the other ; and that arteries will become obliterated in two ways, either by the union of their opposite sides when pressed into contact, or by the organization of the lymph effused around and between their coats when cut asunder by a fine

ligature. Of the greater simplicity of the English operation, there can be no doubt, both as to its actual performance and in respect to the time required for the completion of the healing process; and it has the additional advantage, derived from the ligature being so far sunk into the coats that it cannot slip from its position. To attain this object, a ligature should be sufficiently strong, fine, round, and inelastic. It is unimportant what its composition, provided it possess the above requisites, whether silk, or flax, or leather, or cotton, catgut, or silkworm-gut, for all these agents have been resorted to. The ligature in common use is silk, which should be well twisted and waxed; and, as I have before remarked, there can be no necessity to test its strength by the whole force of the hand; for, although even that force would fail to divide the external coat of an artery, a much less force will suffice for the entire laceration of the two internal coats, if that be deemed necessary. It is undeniable that a soft or flat ligature produces a coarse jagged division, and that a small and fine thread forms an equally clean narrow groove between the coats. It is hardly necessary to say that the size and strength of the ligature should be proportionate to the size of the vessel to be tied.

The arterial tubes are subject, among other diseases, to a morbid change in the structure of their coats, by which the vessel becomes dilated, and is no longer competent to its functions. The disease, which is called an aneurism, from the Greek, is of two kinds: one of which consists of a dilatation of all the coats of the vessel; the other of a dilatation of the two external coats only, the internal or serous coat being broken down and partly absorbed. This fact was established by Mr. Hodgson, and is admitted by most modern pathologists.

The usual tendency of this disease is to increase, till the tumor reaching the skin, bursts, and a fatal hemorrhage terminates, more or less suddenly, the patient's life. With a view to obviate this fatal result, it is the duty of the surgeon to cut off from the aneurismal tumor the current of blood that passes through it, and to call on the vessels of the limb for a new distribution. The tendency in an aneurismal tumor to increase in size is due to the action of the heart, which operates on the diseased coats of the vessel with sufficient force to maintain an uninterrupted enlargement in the volume of the tumor. Against this mechanical force we have the influence of absorption, the *vis medicatrix*, or what may be termed nature's indisposition to disease. If these two powers are equally balanced,

the disease would remain unaltered: but the force of the heart usually predominating, the tumor increases. If that force, however, be reduced in degree, and, without being destroyed, if it be brought within the influence of the *vis medicatrix*, the tumor will be gradually absorbed. It is not, therefore, indispensable to recovery that the tumor should cease to pulsate, but simply that the force of the current through it should be limited. Thus it is no necessary indication of the probable failure of an operation for aneurism, if pulsation return to the sac on its completion, for the force of such pulsation is now reduced within that of the *vis medicatrix*, and the tumor becomes gradually absorbed.

But aneurismal tumors are the subjects of further division, dependent on the composition and formation of the sac or cyst. Tumors containing blood, and communicating with the interior of an artery by an opening in its walls, are not the necessary product of a dilatation of the coats of the vessel; or the dilatation may be complete or partial. By the term *true* aneurism, we understand that form of the disease caused by dilatation; by the term *false*, we express that modification, which is the effect of rupture with dilatation. In addition to the above, we employ the terms *circumscribed* and *diffused*.

The nomenclature generally adopted employs the term "true" to designate the form of aneurism dependent on the dilatation of one or more of the coats of the vessel; "false circumscribed" to that in which the coats are destroyed, and the dilatation consequently imperfect, being formed by the surrounding cellular tissue only. The term "diffused," and which can have no claim to the title of aneurism, is applied to the consequences of a puncture or a rupture of an artery, by which the blood is extravasated into the cellular tissue of the limb; and, lastly, we have a fourth variety, caused by the more or less partial absorption of the entire coats of the artery, and in which the sac is formed, either partially or entirely, by the sheath of the vessel, or by the cellular tissue around it, organized into a membrane: this is termed "false diffused."

For practical purposes this is a very worthless and objectionable division, for, surgically speaking, we have no means of ascertaining whether an aneurism be true or false, nor of distinguishing "false diffused" from either "true or false circumscribed," while "true diffused" aneurism is notoriously no aneurism at all. False diffused aneurism is circumscribed, and in the hands of the surgeon is treated

on the same principle and precisely by the same means as a circumscribed aneurism. In fact, two varieties of treatment embrace the four varieties of disease.

To the surgeon in his pathological character, it may be interesting to determine the exact nature and proximate cause of the tumor, but as connected with practical surgery, there is no feature of the disease which he is less desirous of the opportunity to become informed upon, and none which, had he the power to acquire a perfect knowledge of, would prove of less value to his patient. All aneurisms, requiring the obliteration of the vessel supplying them, are, in one sense or other, "circumscribed." If they are not so, the operation usually adopted would be a most inefficacious one. It is because they are *circumscribed* that it is so generally successful. There is but one form of "diffused aneurism," varying in degree of diffusion, or pouring out, and to that the common operation is inapplicable.

The disease caused by venesection at the bend of the arm is practically, though not pathologically, a circumscribed aneurism. The blood escapes from the vessel, and forms a sac of the cellular tissue around. It is the result of a wound in the artery, however, and not of rupture from dilatation; and the addition of the injury to the vein, which receives a portion of the escaping blood, has nothing to do with either the disease or the treatment.

All aneurisms admitting of cure by the obliteration of the vessel leading to and supplying them are circumscribed, whether the sac be formed by a dilatation of the three coats, of two coats, or of the cellular tissue condensed into a coat, and whether the distension of the latter be considerable or otherwise. For practical purposes, then, the terms circumscribed and diffused are of little value to the surgeon.

In consequence of the current of that portion of the blood which escapes from the artery into the sac being arrested by losing the force of the heart's action, it coagulates, as is well known, in concentric layers. The contents of the sac may be composed of solid and fluid blood in any proportions. We occasionally find the aneurismal tumor solid and firm throughout its entire circumference. At other times it is equally soft, indicating that its contents are chiefly fluid. It is the duty of the surgeon to examine the sac carefully, and to ascertain the nature as well as the quantity of its contents. If firm and incompressible, and if painful on pressure, the contents will consist of coagulum. If soft, and dilated in size, the proportion

of coagulum will be small. If the surgeon now apply one hand on the artery, above the disease, and press with sufficient force to arrest the circulation, and place the other on the tumor, on which he should exercise gentle pressure, he will empty the sac of its fluid contents. Thus he will be able to judge, by the quantity of solid coagulum left behind, about what is the proportion of each. The excess of one over the other state of the blood depends greatly on the form and size of the opening in the artery leading into the sac. If the opening be large, the contents will be mostly fluid, and this is readily tested by observing the length of time required to fill the sac. If the pressure on the artery above be suddenly remitted, after having been continued sufficiently long to empty the sac of its fluid contents, while the other hand is placed on the tumor, we shall be enabled to ascertain with some precision how many pulsations of the artery are required to fill the sac, and the rapidity with which the cavity is redistended would lead to the opinion that nearly all the blood takes this direction. I have known the short period of six or seven seconds sufficient to distend a large aneurismal tumor in the ham. The nature of the contents of the sac may also be inferred, with some approach to truth, by the character of the pulsations, which are more distinct, both to the sense of sight and touch, when the contents are solid. One singular feature in the case I have just alluded to is worth further mention. In the year 1842, a man was brought into St. Bartholomew's Hospital with a large tumor in the right ham. Opinions were very much divided as to its nature. Some deemed it aneurismal; the majority not. The tumor entirely obliterated the popliteal cavity, and extended upwards between the flexor muscles of the thigh half way between the knee and hip-joints. The pulsations were scarcely perceptible. I examined the case very carefully, and fully convinced my own mind that it was a case of popliteal aneurism, of a nature which I can only express by saying it was exceedingly diffused for a circumscribed aneurism. That the blood had escaped from even the dilated coats of the vessel I felt confident, from the fact that the tumor extended many inches higher than the point of entrance of the artery into the popliteal space. On the following day I examined this case in company with my late friend Mr. Langstaff. After a full inquiry, he said he considered it a malignant disease, and was leaving the ward when I requested him to renew his examination. I then introduced my hand under the bedclothes, and placed my thumb on the iliac artery,

begging him once more to place his hand on the tumor. I then compressed the vessel, unnoticed by him, when he exclaimed, with infinite surprise, "Why the tumor is going away! It's gone away!" Remitting the pressure, the tumor again filled with rapidity, when his expressions of astonishment were still greater. I then explained the mystery, and he left the ward with the fullest conviction that the malignant disease was a case of aneurism. And so it proved. The man was operated on and recovered. On another occasion I applied the same test to a case of doubted aneurism of the brachial artery, in the presence of several medical men, most of whom were previously skeptical as to its nature.

A form of aneurism, distinct from any yet described, consists in the escape of a portion of the blood from the channel of the vessel into its coats, in consequence of the separation by disease of the inner membrane. This blood travels between the inner and middle coats, to a distance along the vessel, and then returns to the main channel. The name of a "dissecting aneurism" is given to this form of disease, from the action of the blood on the coats of the vessel, when in a morbid condition; but its occurrence is rare.

Large aneurisms occasionally undergo a spontaneous cure; and, although such a result is a very rare event, in relation to the aggregate cases of this disease, yet the occurrence is sufficiently well known as incidental to aneurismal diseases, to become an important matter for consideration in some of the most formidable examples in which the operation is generally fatal. This end is effected most frequently by the sloughing of the tumor, which process may possibly be the result of increasing pressure on parts not very fully organized. The whole tumor undergoes a change of color, loses its vitality, and eventually separates, leaving the artery pervious to blood.

Sometimes the sac is attacked by suppurative inflammation, and the entire mass is converted into a large abscess; and thirdly, the contents of the sac, already partly solid, may become entirely consolidated, the entrance of any additional quantity of blood being precluded by the blocking up of the orifice, and the tumor becomes gradually absorbed. These exceptions to the general rule, with regard to aneurismal tumors, are so far rare as to offer no serious obstacle to the treatment by operation, when the disease attacks a vessel among the small class of the secondary, or any other ternary divisions; but, in calculating the chances of success attending an

operation for tying the subclavian or iliac vessels, this question should not be omitted.

The symptoms of an aneurism of the usual or spontaneous kind are generally unequivocal, but by no means invariably so. Enlarged absorbent glands in the neck, held down in contact with the carotid artery; partial enlargement of the thyroid body, compressing the same vessel; or the same tumor, having acquired a jerk from the pulsation of its own arterial system, may be mistaken, by a superficial examiner, for carotid aneurism. In the course of the year 1848, I had three such cases sent to me for operation from the country. Tumors in and above the axilla, raising the clavicle, may lead to the supposed presence of aneurism of the axillary trunk. Enlarged inguinal glands, or other forms of incipient disease, extending upwards into the iliac fossa; general inflammation of the absorbents of the ham; great enlargement of the bursa, under the semi-membranosus, may be mistaken for disease of the iliac, femoral, or popliteal arteries.

These few examples are among the numerous sources of error that prevail with respect to diagnosis of aneurismal disease; but close inquiry and a fuller investigation rarely fail in exposing its real nature.

The most striking feature is a pulsation of the tumor synchronous with the beat of the artery; not the effect of a mere movement of the tumor in unison with its pulsations, but a general swelling, caused by universal expansion of the cyst; and which is more or less distinct, as the contents of the sac are more or less fluid. The movement of the tumor is greater in a case in which the contents are solid;—the expansion, when fluid. The tumor should occupy the line of a well-known artery, and generally some well-known region, such as the groin, the ham, the neck, or the supra or subclavicular region. If the artery be compressed above it, the tumor. will decrease in size, and swell out to its former magnitude on remitting the pressure. If the tumor be not aneurismal, its magnitude will continue unaltered. Of all the signs of aneurism this is the most uniformly unfailing.

On applying a stethoscope, or the ear, to the tumor, a rushing sound is heard; to which, such is the poverty of our language, the term "bruit" is still applied by English physicians. This sound, however, is not confined to aneurismal disease.

The arterial system beyond the tumor is generally affected; that

is to say, the vessels are reduced in size, from the encroachments of the tumor on the main vessel, and by the interruption of the direct line of the current, consequent on a certain quantity of the blood passing into the sac. The proximity of the diseased artery to its corresponding vein causes more or less obstruction to the venous blood, and the consequence is, swelling of the limb below the tumor. Too much importance, however, should not be attached to this feature, which other diseases have often in common with aneurism. Pain below the tumor is a frequent concomitant of aneurism. Aneurism in the popliteal region is frequently attended with pain in the calf of the leg.

The nature of the disease being determined, the surgeon is now to select the best means of obliterating the vessel leading to it. The opinion formerly prevailed among pathologists of the necessity of postponing the operation until the collateral circulation was fully established; but an improved physiology has shown such postponement to be unnecessary, such is the activity of the vessels, and such are the necessities of the part below the disease.

Compression of the arterial trunk above the tumor is a remedy of some antiquity; but this form of treatment labors under the objection of the close apposition of the nerve, whether in the carotid, subclavian, axillary, or brachial regions, on which continued pressure could hardly be applied without some danger to the sensibility of the limb.

Still the application of this principle of treatment is becoming more fully appreciated. My friend, Staff Surgeon Dartnell of Chatham, informs me that he has had two highly successful cases, in the second of which he found the artery entirely obliterated within sixty-seven hours; and Mr. Stanley has recently treated cases of popliteal aneurism with some success in St. Bartholomew's Hospital, by means of pressure made on the femoral. (*See* TOURNIQUET).

The next consideration relates to the part of the vessel to be selected for the operation. It is most desirable not to approach too near the aneurismal tumor in all the forms of spontaneous disease, lest the condition of the artery precipitate in the diseased state of the tumor. On the other hand, in traumatic aneurism, produced by a wound, we may expose and tie the vessel close to the tumor. In this selection, we pay little regard to the question of future supply, having the fullest reliance on nature's assistance in meeting this apparent difficulty. The world is indebted to Mr. Hunter for the discovery

of this important fact. He proved that the vessel leading to an aneurism might be obliterated by a ligature tied around it, at almost any distance from the disease, provided it be the only artery supplying it. He pointed out to the profession of surgery, that we might fully rely on nature's co-operation, not only in arresting the disease, but also in supplying the parts below with an ample quantity of blood. The merit of this great discovery is claimed by the French surgeons, on behalf of a countryman of their own, M. Anel; but the arguments on which the claim has been made have been wisely kept in the background. And, in the ingenious endeavor to account for Mr. Hunter's supposed claim, it is even suggested by M. Velpeau that some of the English students, *who then as now* frequented the Parisian hospitals, may have carried the principle with them on their return to London, and possessed Mr. Hunter of it!

The selection of the part of the artery for tying will, of course, depend, in some degree, on the facility of its exposure. The femoral artery is usually tied at a distance of one-third down the thigh from Poupart's ligament, in cases of popliteal aneurism, because it is more easily exposed in that situation; modified, however, by another consideration, viz., the situation at which the first large branch is given off above it. When a ligature is applied around a vessel such as the femoral artery, it is of the utmost importance that space be left between it and the first considerable branch along which the inosculating communications will be immediately carried on, for the purpose of forming a coagulum; otherwise the blood will not coagulate in the vessel above the ligature, but pass along the inosculating branches in a fluid state, and the concussion of such blood, and the pulsations of the artery may tend to break down, and eventually to destroy, the union of the opposite sides of the artery, causing secondary hemorrhage, as it is improperly termed. The form of the clot above the ligature is dependent on the distance from it to the first considerable branch. It is always more or less conical, with its apex towards the ligature and the base directed upwards. It is the supposed office of this clot to break the force of the current against the ligature, to protect it from the consequence of the continued impulse of the blood thrown into the vessel by the heart. It is, therefore, of importance to select that part of the artery for the purpose of exposure that is free from such objections. As a general rule, a full inch is, perhaps, the minimum distance at which it would be safe to apply a ligature around so large a vessel as the

femoral. Where smaller arteries are concerned, the distance may be reduced.

Later observations have tended to throw some doubt on the indispensability of the presence of the coagulum in the artery above the ligature, in consequence of complete union having been occasionally perfected without it. A case to this effect is detailed by Mr. Travers, in which a ligature was applied around the external iliac artery, between the origins of the epigastric and circumflexa ilii arteries; but in consequence of ulceration of the epigastric, the patient died of hemorrhage. On examining the artery after death, no coagulalum was found within it, although the union of the opposite sides of the artery at the ligature was complete.

The line and direction of the artery being determined with exactness, an incision should be made over it, of a length proportionate to the depth of the vessel from the skin, but it should always be ample. This line is usually directed to be made parallel to the vessel beneath it; and although this rule has the sanction of the highest authorities in this country and on the Continent, I venture to suggest a doubt whether an important modification of this practice may not be an improvement upon it. I almost invariably adopt an *oblique incision*, and generally at an angle with the artery of 45°, on the following grounds: that in fat subjects it is difficult to ascertain the exact line of the vessel, and that, however true the first incision may be, it does not follow, in the course of a slow and bloody operation, that the same line will be preserved; that if from accidental circumstances, the precise position of the artery be lost, the operator is equally uncertain whether he is dissecting on the inner or on the outer side of the vessel, or upon it; that, by dividing across the direction of the vessel, he acquires a confidence, from the conviction that the artery is really under his knife; and, lastly, that he makes an external wound, within which the ligature needle is more readily carried round the artery in a fat subject, in which the vessel lies deep, than in a wound parallel to it. The objection to a directly transverse wound is that the artery is exposed only in a transverse line, and there is nothing gained, but much may be lost. In the femoral, brachial, radial, and ulnar, and posterior tibial, I consider the oblique incision to be an important element of success in finding the artery with facility. Take the example of the posterior tibial artery, how preferable is it to make an external incision over this deeply seated vessel, across the line formed between the muscles

that surround it, to the endeavor to hit the exact line, where the deviation of one-eighth of an inch would carry the surgeon into the substance of either of two muscles, neither of which he would be able to distinguish from the other! I remember many years since to have seen a practised operator totally fail in his attempt to tie the ulnar artery immediately above the wrist, from this difficulty.

The sheath of the artery should be cleanly divided, and the coats of the vessel exposed, otherwise we cannot feel confident that we may not include any other structure than the artery itself. If necessary, the sheath may be divided on a director, or it may be cut with a silver knife. Safety is our first consideration; display, if requisite, should follow at a considerable distance behind. The needle should be selected that will most readily effect its object, which, of course, is that of passing with facility around the vessel. The edge of this instrument should be neither too acute nor too blunt. In the attempt to carry it round the artery, a slight force only should be employed. The instrument should be so finished as to be enabled to cut its way by a gentle lateral movement of the hand. If too acute, it may penetrate the artery or the vein; if too blunt, it will require more force in its introduction than the delicacy of the operation justifies.

Of all the varieties of aneurism needle, from the common instrument bearing that name, to the very ingenious invention of Mr. Weiss, which, dividing into two parts, catches the ligature by a spring clasp, I prefer that here sketched, which is a modification of the needle invented by Mr. Alcock, but I conceive improved, by being carried out farther at the point than the needle in question.

The artery should not be unnecessarily separated from its sheath, from which it derives its vessels, the laceration of which, if considerable, may be presumed to be injurious; though I am inclined to think more importance has been attached to this principle than it merits. I am not aware of any example of positive injury, such as secondary hemorrhage, that has been unequivocally traced to the operation of this cause, the evil of which would appear still less imminent, when we consider that the consequences of such separation between the artery and sheath would, under nearly all circumstances, have ample time for the recovery of the natural relations between the vessel and its sheath, before the ligature would separate spontaneously from the artery by the natural process of ulcerative absorption. But this argument, although apparently sound, forms

Fig. 24.

no justification for laying aside the rule above given, not to separate unnecessarily the artery from its sheath, because there is no necessity to do so, which alone is argument sufficient; but in opposition to all the experiments, and all the comments upon them, a case might occur in which such a proceeding may be injurious; and, at all events, it must be deemed a step in the wrong direction, and as such, is to be avoided.

The ligature being passed around the artery, should be drawn tight with a force sufficient to cut asunder the two internal coats. All force beyond this is superfluous. The thumbs should be employed for this purpose, around which the ends of the ligatures are drawn, while placed as closely to the artery as possible, with a view to prevent the unnecessary separation of the vessel from its sheath. When the ligature is placed around the artery, and before tying it, the surgeon should examine carefully the structure about to be included in it, and the attention of one or more assistants called to the same observance. No professional attendant has a right to exempt himself from the responsibility of an opinion, if any doubt exist on the subject, as to the perfect or imperfect completion of the operation. Each should examine the relations of the ligature to the vessel, and express any doubt that may occur to his own mind, whether the vessel about to be inclosed in the ligature be really the artery,

and whether any other structure than the artery be still in contact with it. One end of the ligature is then divided, and the other end brought through the outer wound, to a length of about three inches beyond it. Over this end, a piece of plaster may be at once drawn, to protect it against injury. The wound may be united by the first intention, the edges being brought and maintained in contact, in the mode described at page 56. The period of time that will elapse before the ligature comes away varies with the size of the vessel, and is always very uncertain. For the femoral, from fifteen to eighteen days will be required; for the brachial, some days less; for the radial or ulnar, from eight to ten days, and so on. The process of union of the opposite sides of an artery, and its consequent obliteration, is, however, not to be determined by the period of separation of the ligature, which may be protracted by other causes influencing a remarkable tolerance of its presence by the granulations within, to which it will occasionally cling with tenacity for many weeks. In his experiments on this subject, Mr. Travers has proved that the removal of a ligature within even a few hours of the operation for applying it, may be effected with safety, and the entire obliteration of the vessel secured. But, as a general rule, it is better, because safer, to leave the ligature to come away by itself, unless the period be a good deal protracted, and then its presence becomes inconvenient, and attempts may be made to hasten its separation by artificial aid, such as winding the extremity around a roll of plaster, and by that means maintaining permanent extension of the thread, or by tying a thread of elastic material, such as caoutchouc, to the end of the ligature, and drawing it tightly round the limb, and fixing it with plaster. At the expiration of some weeks, during which the process of obliteration of the artery must have been completed, there will be little danger in making this attempt, yet it should not be resorted to earlier, nor would the high authority of Mr. Travers advise, or I presume adopt, such a proceeding, however conclusive his experiments on animals, and however sound his reasoning, in favor of the general safety of early separation.

An artery may become aneurismal in a part of its course, so near to a large branch as to preclude the possibility of the passing a ligature around it with safety above the aneurism, or, in other words, between it and the heart. Under these circumstances surgeons endeavor to obliterate the vessel and its sac by means of a ligature

applied around the artery below the disease, instead of above it. The merit of this operation is supposed to belong to Brasdor, and it has been adopted by Desault, Deschamps, by Sir A. Cooper,* more recently by Mr. Wardrop,† and Dr. Bush of New York.‡ It is not selected as being a more eligible operation than that usually resorted to for the cure of aneurism, but simply as an alternative in which the common operation is contra-indicated by local circumstances; viz., where the vessel has not sufficient length to admit of the formation of a coagulum between the ligature and the first great collateral branch above it. Such a condition will justify, and indeed compel, the attempt to obliterate the vessel by a ligature applied below, or on the distal side of the aneurism. Of the six recorded cases of this operation, four have proved fatal, while two only recovered. Of the six examples, four operations were performed on the carotid, and two on the femoral arteries, immediately below the groin. Both the latter proved fatal. The two successful operations were performed on the carotid, one by Mr. Wardrop and one by Dr. Bush.

It is proved beyond a doubt, that a ligature applied around an artery on the distal side of an aneurism is sufficient for the purpose of establishing a collateral supply of blood to the limb; nor does it appear that deficiency of supply of blood has attended any of the above cases. But it is, I think, obvious, arguing, however, from a somewhat limited experience, that the circulation generally, and especially the sac, sustains a greater shock from the operation of Brasdor than from that which is justly termed the operation of Hunter. The impulse on the sac is great, the coats of the artery become consolidated, and in one instance they ulcerated. The operation of Brasdor will only be resorted to in cases of necessity, and as these cases are not of very infrequent occurrence, so it will always retain a position among the resources of the surgeon in aneurismal disease. It is applicable only to arteries giving off no branch, like the carotid. The failure in both examples in which the femoral was tied high up was probably due to the current of blood being continued through the epigastric and circumflexa ilii arteries, while it has been performed by Mr. Wardrop and by Dr. Bush on the trunk of the common carotid with perfect success.

On the completion of the operation for aneurism, the patient

* Sir A. Cooper's Lectures.

† Wardrop on Aneurism, 1828. ‡ Dr. Bush's Case. See Lancet, Vol. I.

being removed to bed, should be placed in a position of perfect rest. His diet should be low. There is usually no necessity to increase the quantity of clothing, or to anticipate any considerable deficiency in the temperature of the limb, so rapidly is the collateral circulation established. Of the numerous untoward consequences enlarged on by French authors, as attendant on operations for aneurism, I know but of two. The first is, that the temperature of the limb is raised, as it is said, by reason of the increased cutaneous circulation; a not very important symptom, and which brings about its own cure in the course of two or three days; and, secondly, in large operations for this disease performed on vessels near the heart, and on them only, the nervous system appears to sustain a shock which demands immediate attention. The symptoms occurring in a case of disease of the subclavian artery, in which I tied that vessel, were very formidable and even alarming. Violent pulsation against the ligature, and along the course of the aorta, a sense of suffocation and of pressure, as though caused by the aorta on the left lung. But these symptoms, more formidable than any I had witnessed, either before or since, yielded to antispasmodic treatment. Nor is it surprising that an operation which has exposed a structure so intimately concerned with, and so proximate to, the heart itself, the susceptibility of which, even under natural excitement, responds so readily to every emotion to which thought can give rise, should be indisposed to tolerate an encroachment on such critical ground.

I am inclined to believe, that it is to this violence done to an important blood-vessel, rather than to the throwing back on the heart the hitherto circulating blood, that these symptoms are due. In Dr. Mott's case, in which he tied the innominata, not the slightest indication of suffering by the heart followed the application of the ligature, which might be expected to attend the operation immediately, and, indeed, the nervous symptoms to which I allude do not usually commence until some hours after the artery has been tied. The same absence of symptoms attended Graefe's operation in Berlin, though it was followed by great constitutional irritation and fever. In speculating on this subject, perhaps we do not always remember that the circulation in the limb is a good deal reduced before the operation, as characterized by the coldness of the limb.

Gangrene is an occasional, though a very rare, attendant on operations for aneurism in this country. It would appear as a more frequent result of similar operations in France. Under any circum-

stances, its extension can have but one result, viz., amputation. It usually commences at the extremity of the limb, and every means should be employed to arrest it. Stimulants, nutrient food, and artificial warmth should be resorted to most sedulously. The part should be covered with hot flannels, and a hot bottle applied to the distal surface. If these and similar agents fail to arrest its progress, and to stimulate the enlarged vessels to more active duty, the preservation of the limb becomes hopeless.

The decision as to the place for amputation is a difficult one. If the gangrene proceeds with rapidity and extends up the limb, amputation should be performed very little below the ligature of the former operation; but, on the other hand, if the progress be slow, if the temperature of the limb retain that of the rest of the body, at least to within a short distance of the gangrenous surface, the removal of the limb may be postponed, and eventually as much of it retained as may be conducive to the future wants and necessities of the patient.

I have alluded to the treatment of aneurism by pressure. It remains for me to add a few words on the principle here referred to, and its application to the cure of this disease. A sufficient number of recorded examples of the successful treatment of aneurism by means of local pressure have occurred, within the last few years, to demand something more than a passing comment on the subject. The first consideration due to any large case of operative surgery is the danger of the result. This danger, however, in this instance, is rather comparative in degree than positive, nor does it refer necessarily to danger of death, but rather to other and well known evils sustained by the constitution, short of that of a fatal issue. Whatever the amount of danger be, it cannot be denied, that all approach to it is avoided by substituting the tourniquet for the knife. We avoid a shock to the constitution, whether mental or physical. Then, as regards the question of pain, we now discuss the subject in a different aspect from that it presented before the introduction of chloroform; the value of which, however, is less appreciated in operations for aneurism than in most other operations of equal magnitude. But the presence of pain, as an attendant evil, is not to be confined to the treatment by operation; for, although severe enough during the performance, it is of short duration, while that of pressure, though not severe, is protracted throughout the treatment.

The consideration due to the question of time, also, is not to be

unhesitatingly granted to the operation, because the entire obliteration of the artery may occur in as short a period as the recovery from the operation would usually require, or nearly so. In Mr. Dartnell's case, the recovery was effected within the average period of recovery from an operation. If, therefore, we balance the account of advantage and disadvantage between these three important questions for our decision, as to the more eligible course for adoption, we may reasonably resort to pressure as a legitimate experiment, satisfied that we avoid danger, we dilute if we do not obviate pain, and we reach our goal within a term a little more extended, possibly, than by the adoption of what is usually deemed the direct mode of cure. The question then arises as to the competency of the agent, and its applicability to any given case of aneurismal disease. It is established beyond doubt, that the application of continued pressure upon the trunk of an artery, between the tumor and the heart, is competent to the permanent obliteration of the vessel. If it can be worn for a sufficient length of time, its competency is undoubted; but here lies the difficulty, which qualifies its more general application. The majority of the large arteries, the usual seat of aneurism, are accompanied by the corresponding vein, and by the chief nerve of the extremity. It is impossible to compress the artery without in an equal degree subjecting the nerve to the same compression, and this compression creates pain, often unbearable. The liability to this objection can only be ascertained by experiment. The larger the nerve, probably, the greater the liability; and on this account, therefore, the treatment by pressure is more efficacious in popliteal aneurism of any other locality in the body. As regards the cases to be selected, a solid sac is preferable to a large and fluid one.

The instrument employed should be a tourniquet, of which that which I have elsewhere described is, I conceive, the best suited to the purpose, by compressing the artery along a considerable portion of its length, but leaving the venous system of the limb free, as regards the secondary branches of the chief venous trunk. The pressure should be employed gradually, and increased day by day, if bearable. Possibly from four to six hours will suffice for the first effort, and it should then be relaxed for the purpose of relieving the patient from the pain incidental in some degree to all such pressure as is here required, the amount of which, however, should be sufficient only to stop the circulation through the vessel; but, in the mean time, pressure might be employed elsewhere on the trunk.

In the course of a few days the pressure may be continued for eight or twelve hours, with short intervals of relaxation of an hour or two, or more. The principle of the instrument should be explained to the patient, who, being permitted to control it at will, will be more tolerant of the suffering. It is not proposed that the pressure be entirely removed at any time, but only partially relaxed; and respecting the degree at which it should be employed, it will partly depend on the natural obesity of the person, and also on the care taken in the application of the instrument, to direct its force as much as possible against the bone. Should the suffering be unbearable, whether locally at the points of contact of the instrument, or throughout the limb; if his health be deranged by loss of appetite or want of sleep; or the extremity become very œdematous, the operation by ligature should be resorted to.

But notwithstanding the occasional objections attendant on the application of pressure, as the agent of cure in the treatment of aneurism, a sufficient amount of success has already attended the experiments that have been tried, to warrant the hope of a useful, if not a brilliant career for this remedy, when additional experience has divested it of its objections. Although the continuous pressure on the artery is always more or less painful, yet, as in the case of the femoral artery, in which we have length of the vessel at command, the locality of the agent of pressure should be changed from day to day, or from hour to hour, and be modified in degree, according to the susceptibilities and endurance of the patient. I extract the following from a correspondence I have lately had with Mr. Dartnell, who says, "I treated the first case of popliteal aneurism four years ago. The tumor was the size of a hen's egg, and of four months' duration. I applied pressure in two places, the groin and in the lower third of the thigh, by means of wooden clamps. Each was tight alternately. The coagulum was firm, and the instruments were removed on the fifth day. Within two months this man, a soldier, returned to his duty, and has been well ever since. The second was a case of femoral aneurism, large in size, its upper edge two inches below Poupart's ligament. The pulsation was very powerful. I applied a modification of my own truss for pressure on the artery, as it passed underneath Poupart's ligament. The amount of pressure was so regulated that the current of blood through the tumor was only partially checked, until it was found that the previously diminished temperature of the limb was fully restored,

through the medium of the collateral circulation. The screws were then tightened, and the pulsation in the tumor completely stopped, and in less than three hours from this time the aneurismal tumor was completely solidified, exactly twenty-nine hours from the first application of the instrument, which was then relaxed, and in thirty-eight hours more was altogether removed. I selected this latter case for pressure, because I thought it an unfavorable one for operation, as there appeared to be general disease of the arterial system, evidenced by a slight 'bruit' of the aortic valves of the heart, of the abdominal aorta, and of the external iliac arteries. Strange to say, these symptoms altogether disappeared since the cure of the aneurism."

I give the above case on the authority of a highly competent member of our profession, and I do think they give abundant earnest of future success, should the experiment be more fully carried out. One thing is quite obvious, viz., that the common tourniquet is totally inadequate to answer the necessary indications, in consequence of the distension of the limb and general œdema, that must always attend its persistent application.

OPERATIONS ON WOUNDED ARTERIES.

The surgeon is frequently called upon to apply a ligature around an artery, in consequence of a wound in the vessel causing hemorrhage. In no form of accident or injury are his knowledge, his manual dexterity, and his patience and self-possession more in request than on the occasion of hemorrhage from a large and deep-seated artery. A knife, or other cutting instrument, may have penetrated or have transfixed a limb. If the bleeding be considerable, it is obvious that a large artery is wounded. Certain indications generally present themselves when the accident has involved a large vessel. The line of the wound points in the direction of the main artery of the limb; the flow of blood is very copious, resisting for a time the efforts of the bystanders to arrest it; the escape of the blood is attended by an audible rushing sound; syncope follows the first flow; the patient's face is pallid, and its expression betokens alarm. Such symptoms would usually attend hemorrhage from the iliac or femoral arteries, and other branches of the secondary class.

If the wound has penetrated the limb lower down, or transfixed it through, or nearly through the centre in a transverse direction, we

may have some difficulty in determining what vessel is the seat of the injury. It may be the radial or ulnar, the posterior tibial or peroneal. But be it where it may, the safety of the patient almost invariably requires that we explore the wound, expose it to view, and pass a double ligature around the bleeding vessel. When such a case presents itself, the first measure to be resorted to is to put a tourniquet around the limb above the wound, which, supposing the hemorrhage to have ceased, may be applied with moderate tension, so long as the surgeon, or some competent representative, be near at hand.

The next duty of the surgeon, having placed his patient in safety, is to make all needful inquiries into the case, the nature of the accident, &c. He may learn, with advantage, the kind of instrument which caused it: he may pass into the wound a probe or a director, not, however, for the purpose of reaching the artery, which would be perfectly useless, but simply for that of ascertaining the direction of the wound. It is very desirable that he acquires accurate knowledge of the nature and extent of the hemorrhage, on which subject great deception prevails among the bystanders, who amplify to a most erroneous degree, and mislead the surgeon from the truth. One man is content with the assurance that the wounded man has lost a pint or a pint and a half of blood, while the statement of another doubles the quantity without hesitation. It would be desirable, if practicable, that the surgeon should himself bear witness to the amount of hemorrhage that has occurred. The chief advantage of this information is that it may enable him to form a tolerably correct opinion as to the size of the wounded vessel, and thus determine the operation he will perform.

Suppose a man to have sustained a punctured wound on the inner part of the thigh; if the surgeon can ascertain that the rush of blood was vehement; that it was attended by a gushing sound; that the patient became rapidly pallid; that his clothes, and a large quantity of linen, became quickly saturated with blood; and, finally, if, on examination by the probe, the wound takes the direction of the trunk of the femoral artery, scarcely a doubt will exist in his mind that the main artery is wounded. While, supposing the direction of the instrument to have passed in a line half an inch only backwards through the limb, a perforating artery may be the seat of the injury, and all the above symptoms may be greatly modified in degree, although the report of the witnesses will still declare the

loss of blood to have been most alarming. To the timid and inexperienced practitioner, such forms of hemorrhage *are* alarming; for ignorance and inexperience are natural and reasonable sources of alarm in such cases. If there be one trait above another that pre-eminently characterizes the experienced and the competent surgeon, it is the perfect self-possession with which he undertakes and conducts to its close an operation of this kind. A large hospital, and a long experience, constitute the best conditions for its acquisition. A thorough knowledge of the arterial system is, indeed, indispensable, and that alone can give us confidence in our own power to meet the endless variety in the catalogue of these injuries as they occur in hospital practice.

I was called by Mr. Reece, of Sussex Gardens, in the course of last year, to the case of a butcher who had sustained a punctured wound in the thigh, which, until he applied a tourniquet to the limb, had bled very freely. The nature of the accident was a singular one. The man was standing in his shop, at some distance from the block on which he had just deposited his knife. One of his men brought in a large mass of beef, which he threw down on the block. The beef caught the knife by the handle, turned it over, and threw it, like a dart, against his master's thigh, at some distance off, which it penetrated to the depth of some three inches. The man was lying on the ground, in a back room, wrapped in his bloody linen; but the quantity of blood lost did not appear to exceed a pint, and some minutes must have elapsed before his neighbor, Mr. Reece, reached him. The butcher's great anxiety appeared in the apprehension, which he repeatedly expressed, that he was not damaged in the "Pope's eye." The dissection was an elaborate one; the femoral artery was untouched, but one of the perforating arteries was cut across.

When, from the above evidence, we have reason to believe that a large artery is wounded, it is usually our duty to tie it at once. There may be circumstances, however, under which we are, perhaps, justified in the resort to pressure as the means of obtaining obliteration of the artery in a punctured wound. If many hours have elapsed without a return of bleeding; if pressure could be efficiently applied on the vessel in the direction of the bone, as in the case of the femoral artery punctured half-way down the thigh; or a very impaired state of the health of the subject, or a great liability to erysipelas—such arguments might be urged in such cases as extenu-

ating circumstances, justifying the resort to pressure under the protecting influence of a permanent tourniquet. But, under almost all circumstances, we should tie the artery.

When we have reason to feel confident in our knowledge of the nature of the injury, and in that of the artery wounded, we have the option either to follow the puncture, by dilating the wound in its course, or to reach the artery, which we have good reason to consider the seat of the wound, by what I may term an anatomical and more direct path. In the first operation, the director, introduced throughout the entire depth of the wound, is our guide. It has the great objections of a wound probably of considerable depth, and made through the substance of any muscle or muscles divided by the instrument; the counter-advantages consisting in the great probability of reaching the wounded vessel. It may happen that the artery which is wounded lies considerably nearer to the opposite side of the limb, and from which it is reached with facility. The direct route to an artery is that which of course would be usually selected, though it may labor under the disadvantage of uncertainty as to the vessel wounded: but it may yet prove the preferable operation, especially if, as in the case of a wound in the profunda or perforating arteries of the thigh, nearly the same operation will be applicable to the two vessels.

When the wounded artery is exposed to view, and the aperture in the vessel distinctly seen, two single ligatures should be placed around it, one of which should be tied above, and the other below the wound, each at a distance of a third of an inch from the puncture; the office of the lower ligature is to prevent the return of hemorrhage by the collateral circulation. One end of each ligature may be removed, and the two remaining ends brought out through the outer wound, which should be healed by the first intention, if possible, in order to obviate the consequences of extensive suppurative action being established. The operation, for the same reason, should be done with as little violence as possible to the structures divided; for if the wound be continued, and the surfaces jagged, it may prove a serious obstacle to such form of primary union of its opposite sides. If the operation be much protracted, and the injury to the surfaces consequent on the difficulty of finding the wounded vessel be great, it would be desirable, that *all the exposed portion* of the artery be insulated by the two ligatures—

placed as widely asunder as possible—lest the vessel inflame in common with the parts around, and again give way.

If an artery be wounded immediately above or below its junction with a large branch, the ligature most remote from the branch should be applied as usual, but danger may attend the process of reparation, consequent on the application of the other. If the branch in question be given off above the wound in the vessel, the lower ligature may be applied with safety around it; but the other ligature should include the trunk above the branch, supposing a less distance than nine or twelve lines existed between the wound and the branch, or rather between the ligature, if applied, and the branch. As a general rule, it would be safer to tie the artery altogether above the branch, if the latter be of considerable size, on the general principle previously discussed. If the branch be given off below the wound, within six, or even nine lines distance, it will be safer to employ three ligatures, one for the main trunk above the wound, one for the main trunk below the wound, and one, also, for the branch intermediate to the two. It is quite indispensable that the wounded portion of the artery be insulated from the circulation, such is the activity of the inosculating system of the body. A single ligature applied around an artery above the wound can answer no useful purpose, unless a second be applied below the aperture. There is no fact in surgery more indisputable. Abundant examples of secondary hemorrhage are on record, consequent on the application of a single ligature; and I know no better illustration of the part than that offered by the practice of a late eminent surgeon, who, in the case of a gun-shot wound in the groin, followed by continued hemorrhage, proceeded to tie the external iliac artery. The patient died from hemorrhage from the circumflexa ilii, which was unrestrained by ligature.

It is a considerable aggravation of injury if the vein be also wounded or transfixed by the instrument. This circumstance renders the result less promising, but cannot justify any departure from the principle of the operation. The wounded vein must be cut off from the circulation by means of one or two ligatures; I say one or two, because the valvular structure of these vessels, their profusion in number, and the comparatively torpid movement of the blood within them, may justify the application of a single ligature below the wound. Yet there would appear to be little reason in rejecting the second. An opinion is very prevalent in the profession, that a

ligature applied around a vein is the cause of danger, by promoting inflammation along its coats. That such inflammation may be an occasional occurrence, is indubitable; but it is, certainly, by no means a frequent one. I believe the reports of danger consequent on the application of a ligature around a vein to be greatly exaggerated. In the case of a puncture, however, we have no reasonable alternative but the ligature; and I know of no evidence of any injurious consequences to the vein which would justify us in rejecting it.

Small arteries, when wounded near their origin from a large trunk, will occasionally pour out a large quantity of blood, and very naturally afford ground for the opinion that a large vessel has been wounded. The arm or the leg may be punctured, and considerable hemorrhage may follow, without either of the chief arteries being wounded. Of this I have seen many examples, which have occurred to patients brought into the hospital, when the surgeon has been compelled to rely on the statements of bystanders, who have reported, truly enough, that the bleeding has been great—great in their experience, though far less in that of the surgeon. A butcher was brought into St. Bartholomew's Hospital, in the year 1838, who, in descending from a ladder, had transfixed his forearm, immediately below the elbow-joint, with his steel, which was hanging from a strap at his waist. The man was pallid from loss of blood, and a good deal alarmed. On examining his arm, a wound appeared about two inches below the inner condyle of the humerus, through which the instrument had entered, and it had passed out at a second wound, just below, but somewhat in front of the outer condyle. The evidence seemed to point to the wound of a considerable artery, but whether brachial, radial, or ulnar, it was difficult to say, for either one or even both might have been involved, as blood had poured freely from each orifice. I proceeded (not without a consultation with my colleagues) to explore the wound, by exposing the anterior region of the elbow-joint. I brought into view the three arteries above alluded to, the median nerve, and the tendon of the biceps. I took a careful survey of the entire part of the wound which involved its relation with arteries, and I could find nothing. The man recovered without further hemorrhage.

In cases of hemorrhage from small vessels, there is, in my experience, no agent at all comparable in its power to arrest bleeding like rest and exposure to air. Whether it be the act of exposure to the

atmosphere, or that the vessels are freed from the contact of parts around, I do not know, but the fact is undoubted. The surgeon who has least fear of hemorrhage loses the least blood. A small wound may be tortured by styptics, and by compression, and by other unprofitable agents, till it becomes the fruitful source of protracted hemorrhage. Masses of lint are piled up in heaps upon the wound, pressure is maintained till all the parties concerned are exhausted, but still the hemorrhage returns or continues, by reason of the irritation caused by the very agents employed, and nothing more. Under these circumstances, which I have repeatedly borne witness to, all dressings should be removed; the wound should be opened and exposed to the air, by its edges being drawn widely asunder, and the bleeding apparently encouraged; its surface freely sponged with cold water, the coagula wiped away, and in this condition it may be fearlessly left to bleed. The cessation of the hemorrhage by such means is often immediate. I was called up at an early hour, many years since, by a medical man, to consult with him on a case of hemorrhage from a tonsil which he had removed in the middle of the previous day from the fauces of a young lady. I directed him to take her to an open window, on the side of the house from which the wind blew, and to require her to keep her mouth wide open. On the following day, I learnt that the bleeding, by this simple expedient, had almost immediately ceased. A gentleman, in a state of intoxication, fell down and cut his head. The wound bled freely from the secondary branches of the temporal artery. This hemorrhage continued from seven to twelve at night. When I saw him, his bed was surrounded by some six persons, medical and domestic. The man had a pile of lint of about three inches in thickness on the wound, and another layer was about to be added to the mass. Contrary almost to the entreaty of the parties engaged, I removed the clotted and saturated lint, and roughly sponged the wound, which I exposed to the air. The bleeding ceased within three minutes. On another occasion, I was sent for in the night to the hospital, to assist in arresting the bleeding from a large wound below the axilla, that had been made on the previous day, by my late colleague Mr. Earle. Three house surgeons were present and other persons. This man had lost a large quantity of blood by the same ingenious devices as those practiced in the above cases. I proposed to remove the lint, and I was answered that its removal would be fatal, such was the tendency to bleed. I ordered the man's bed to be carried to an

open window, and removed every appendage from the wound. A large flow of blood followed, and then entirely ceased. I have records of many other similar cases.

Modern surgery recoils from the adoption of the practice of the past, by resorting to amputation of a limb in cases of hemorrhage from a wounded artery, and which has unhappily prevailed even in our own time. The amputation of a limb is perfectly unwarrantable, so long as the most strenuous and persistent efforts have not been made to discover the bleeding vessel. It is discreditable for a member of our high profession to resort to such an expedient as a shield to his own ignorance. If he be unable to detect the lurking evil, it is his duty to apply for the co-operation of those in his own neighborhood, who will at least share his responsibility, if they cannot remedy the evil. It is preferable to tie every recognized artery in a limb before adopting the shocking alternative of removal of the limb. This resource is available at all times, and should only be resorted to when every other expedient has failed. Of this important principle, viz., the necessity of exposing every suspected source of hemorrhage, I will venture to give one example from my own practice. A young gentleman of about seventeen years of age was riding on the roof of a coach in the country, when the coach turned over and fell on his leg, and held it firmly until the vehicle was raised. He was removed to his father's residence, half-a-mile off. The limb was greatly contused, and a flesh wound of about three inches long existed at the side of the calf, which penetrated deeply through the muscles. The bleeding was considerable. Concluding, from the direction of the injury, that the posterior tibial artery was wounded, I cut down to it with such instruments as I could procure, and tied it, but the bleeding continued. I then tied the peroneal artery, but with no better success; and I finally put a ligature round the anterior tibial, but still the bleeding was not arrested. The limb was amputated by Sir Benjamin Brodie, who was sent for from London; I, who was myself a sufferer from the accident, being unable to perform that duty, from the effects of a severe contusion of the knee, of which I was scarcely conscious at the time of the accident.

Half a century ago, the surgical profession were comparatively ignorant of the course of many of the ternary and quaternary vessels. The general principles of physiology had been maintained by anatomical discovery, but surgical anatomy was in its infancy. The

removal of liability to hemorrhage by amputation was a not infrequent resort of the surgeon, consequent on the prevailing ignorance of the arterial system. In our days, such a resort would not be tolerated among competent men. The artery is to be sought for and found; and when each probable vessel has been tied, should the hemorrhage still continue, it would be preferable still to wait and watch the effect of time, pressure, and cold. The latter, however, is but an inefficient agent when employed to arrest local bleeding from an artery. Should bleeding still continue, the limb can but be amputated at last. Again, let me add, that if the arterial bleeding be considerable, it must come from a recognized vessel, which patient exploration rarely fails to discover; if it consists of oozing of blood merely, we should trust to time and position.

ON THE TYING OF ARTERIES DIVIDED IN WOUNDS AND AMPUTATIONS.

In an early part of this chapter, it has been stated that vessels, when first divided by the knife of the operator, bleed most freely, contract in the course of a few minutes, and, during the process of preparing the wound for the application of plaster or suture, are scarcely recognized, and especially so, if the loss of blood at the time be considerable. The principle has also been strongly urged, that, if we desire to effect early and permanent union between opposite surfaces, it is indispensable that we bring them into contact when freed from the interposition of coagulum, and that the presence of blood, whether in a coagulated or in a fluid state, is fatal to union by the first intention or primary adhesion. Great attention, therefore, should be bestowed on securing all the divided arteries that are likely to bleed, for the warmth of the bed will promote the return of bleeding from vessels that have ceased to bleed while the wound is exposed to the air. We must not, therefore, be content with applying a ligature around the larger vessels only, but grapple with them all, and prevent not only bleeding, but oozing of blood. In the case of a stump after amputation, every artery should be sought for, from which blood may trickle, for the quantity may increase, after the edges of the stump are brought together, a coagulum may form, and the adhesive process become interrupted.

In tying the bleeding arteries of a wound, we usually select the largest for the first ligatures. In stumps, the main artery is always

first tied; the ligature silk for which should be strong enough to bear considerable effort of tension; the single thread should be left uncut, in which a knot may be tied, for the purpose of identifying it. Other arteries may then be secured, either by being caught by the common forceps, of which a modification is here represented, invented by Mr. Luke, of the London Hospital, and adopted by Mr.

Fig. 25.

Stanley, or by Assalini's forceps, or even by a tenaculum. If this latter instrument be employed, care should be taken in this, as on all occasions, to raise upon the instrument as small a portion of muscle as possible. It occasionally happens that, notwithstanding our best efforts, oozing of blood still continues. It may proceed, in the case of stumps, from the medullary artery, which is very difficult to arrest, from its having retracted within the sawn margin of the bone. In that case, if the pressure of the finger with some fluc of lint, or the agency of cold air, by exposing it freely, and a reasonable allowance of time, fail in the object, the patient should be removed to bed, and the wound left open for some hour or two. The vein also is a frequent source of difficulty. It should be met by removal of the tourniquet, elevation of the limb, and the influence of time. A few minutes will generally serve this purpose. If the bleeding still continue, a ligature may be applied around it. In the tying of arteries in stumps, or other wounds, sufficient force has been applied, if the inner coats of the vessel have been simply cut asunder; any tension beyond this only endangers the ligature, and can answer no useful purpose whatever.

Where it is proposed by the operator to endeavor to heal a wound by the first intention, or indeed, under any circumstances, too much care cannot be bestowed on the mode of tying the smaller vessels. The forceps should be finely pointed, and be so applied to the mouth of the vessel, as to include the artery alone, and not the surrounding muscle or other tissue. In this respect, the forceps are less objectionable, if well made, than the tenaculum, the curve of which is so large as to pierce the muscle at some distance from each side of the artery, and a large piece of the muscle is thus coarsely in-

cluded in the ligature. It is, perhaps, superfluous to say, that this portion sloughs, and becomes a source of irritation hereafter.

Much confusion prevails with regard to the definition of the terms employed to distinguish the varieties of aneurism. The words *true* and *false* are especially unfortunate in this respect. Many authors define a *true* aneurism to be one in which the sac is formed by a dilatation of *all* the coats of an artery; while the majority of surgeons restrict the term *false* to those aneurisms in which the sac is *deficient* in *all* the arterial coats. I have adopted the following classification.

ANEURISM.

- **True.** The sac is formed either, (1,) by a dilatation of all the arterial coats, or, (2,) by the external fibro-cellular coat alone, the two inner coats having given way.
  - Sacciform. Fusiform. Cylindroid. Varicose. — Terms applied by Breschet to the shape of these aneurismal tumors.
  - The term "*aneurismal dilatation*" is applied to that variety in which the whole circumference of an artery is dilated.
- *Dissecting aneurism* is a very rare variety. The inner or inner and middle coats of an artery having given way, the blood is forced between the coats into the connecting cellular tissue.
- *Hernial aneurism* is extremely rare, the two outer coats being perforated, the inner coat is protruded through the opening.
- **False.** None of the arterial coats enter into the formation of the aneurismal sac.
  - *Circumscribed.* A complete sac is formed of condensed cellular tissue.
  - *Diffused.* Sometimes called *primitive false aneurism.* No distinct sac is formed, the blood is effused into the surrounding cellular tissue through a wound or ulcer in the coats of an artery. If through a wound the term *traumatic aneurism* may be applied.
- **Mixed.** The sac of a true aneurism has given way, and the blood has escaped into the surrounding cellular tissue. (Dr. A. Monro, sen.) To the false aneurism thus formed the term *consecutive* is sometimes applied, to distinguish it from primitive false aneurism.

ON ANEURISM OF THE ARTERIA INNOMINATA.

The arteria innominata is from fifteen to eighteen lines in length. It is placed behind the first bone of the sternum, from about the

middle of which it ascends in an oblique direction to the right sterno-clavicular articulation, where it terminates by its division into the carotid and subclavian arteries. The extent of its elevation above the upper edge of the sternum varies much in different individuals. In many, its pulsation is quite apparent to the extent of half an inch, or even more; while in others, no part of it is perceptible on pressing the finger into the supra-sternal fossa. I think I have observed the innominata to be more elevated in its position in young subjects, in whom its pulsations are more palpable above the level of the sternum than in adult age. It is separated from the sternum by the left vena innominata, which crosses it nearer to its origin from the aorta than to its division above, and. by the sterno-hyoid and thyroid muscles. The artery lies closely in contact with the trachea behind, and is placed obliquely upon it. The right pleura is not in immediate relation with the artery, but lies to its right side (i. e., the right of the individual). The right pneumogastric nerve is placed more than half an inch from its right side; and neither of these objects ought to be exposed in the operation for tying it.

Aneurism of the arteria innominata consists in a simple dilatation of the artery, involving its three coats in a greater or less degree; but it contains no coagulum, for it is a dilatation of the entire vessel. It may be distinguished from aneurism of the arch of the aorta, by its pulsations being more elevated towards the neck. Aneurism of the upper part of the aorta involves the sternum, which is gradually absorbed to the extent of two or three inches down; it conveys an aneurismal thrill throughout the head and each of the upper extremities; whereas, that of the innominata is confined to the right side. Aneurism of the aorta is not a dilatation of the vessel, nor a true aneurism; but a false aneurism, in which the sac communicates with the vessel by a contracted opening, through which blood enters and coagulates. This sac increasing, comes into contact with the sternum and absorbs it. In that of the innominata, the disorganization of structure is less in degree, both from its nature and from its locality. In the latter disease, dyspnœa is of more frequent occurrence than in that of the aorta, from its proximity to the trachea. Often, this symptom, however, is only occasional; it subsides and reappears under excitement.

In the advanced stage, a difference may be perceived in the condition of the venous circulation of the two sides of the neck, in

consequence of the pressure on the left vena innominata by the artery against the sternum. If pulsation, morbid in degree, be felt on applying the finger to the upper part of the sternum, between the sternal attachments of the mastoid muscles in the *early stage* of the disease, the arteria innominata will be its seat, and not the aorta, for the aorta to have reached that level, infers disease of some standing; and, supposing the latter vessel to be the subject of aneurism, the sternum must be involved. A case in point came under my charge, in St. Bartholomew's Hospital, last autumn. A woman, aged about thirty-five, was admitted with supposed aneurism of the innominata. A tumor occupied the front of the sternum, to the extent of about two inches. She suffered little from dyspnœa; the radial arteries pulsated with force, and with the like characters. Although the tumor appeared also above the level of the upper edge of the sternum, and encroaching on the neck, it did not take the oblique line of the arteria innominata, extending towards the right, but occupied the middle of the neck, in the supra-sternal fossa. In the opinion I had formed, Mr. Lawrence, who had subsequently charge of the case, concurred. The woman died in the following December, without rupture of the sac. The disease occupied the upper part of the arch of the aorta, and the innominata was healthy.

Cases of spontaneous obliteration of the innominata are well known to the profession. A case is reported by Pelletan, and a second, by M. Darrach, in which the obliteration extended to the carotid and subclavian vessels, by which all doubt as to the power of the collateral circulation was removed. The conviction of the truth of this fact, and the necessity of the attempt to prolong life in disease of the lower portion of the carotid artery, or of the inner part of the subclavian, has led to the operation for tying the innominata. This operation has now been performed in four or five cases; and, although hitherto no single case has proved absolutely successful, yet life has been prolonged to a period which argues the great probability of future success, should the operation be repeated.

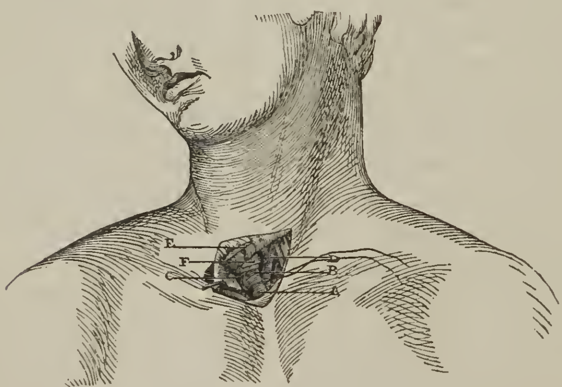
It was first undertaken by Dr. Mott of New York, in the year 1818. This patient survived to the 26th day. The second case, performed by M. Graefe, of Berlin, died on the sixty-seventh day. Both patients died of ulceration of the artery, and in both cases a coagulum was formed in the innominata below the ligature. The application of the ligature was unattended by any serious symptom,

and the right arm and neck obtained an ample supply of blood. The same result attended a case operated on by Mr. Liston, in which he tied both carotid and subclavian close to their origin from the innominata. Here, also, a clot formed in the latter vessel, below the ligature. I do not understand the assertion of Mr. Liston, that in a ligature on the innominata, "there is little chance of a coagulum forming on either side of the ligature." This patient also died of secondary hemorrhage.

Operations for Tying the Arteria Innominata.

The patient should be placed on a table, with his head directed obliquely towards a side window, admitting a sufficient quantity of light, or in a room lighted by a skylight. The head should be thrown backwards for the purpose of rendering the front of the neck sufficiently tense. An incision of at least two inches in length should be made along the anterior margin of the *left* sterno-mastoid muscle. The parts underneath this incision are to be carefully divided, including the cellular tissue and the cervical fascia, of which two laminæ may be exposed. At this stage of the operation the patient's head may be raised on a pillow, with a view to relax the parts hereafter to be exposed. The sterno-hyoid and

Fig. 26.



A. Anterior innominata.—B. Carotid artery.—C. Subclavian artery.—D. Inferior thyroid vein.—E. Mastoid muscle.—F. Sternoid muscles.

thyroid muscles are now brought into view. In dividing the right muscles, great care should be taken to avoid a plexus of veins,

descending from the thyroid body and the middle thyroid artery, should it exist, which are placed immediately behind them. If these veins be unusually large, they will present a serious obstacle to the progress of the operation; and should the depth and narrowness of the wound harass the operator, he should immediately resort to a second incision, made along the line of the right clavicle, detaching also the sternal origin of the mastoid muscle from the bone. An assistant should be occupied in retaining asunder the opposing surfaces of the wound, by efficient retractors; not the edges merely, but on the right side the sterno-mastoid muscle, and on the left, all the structures down to the exposed trachea. From this stage of the operation there is no warrant for the use of a cutting knife, which may be laid aside. The patient should be directed not to swallow. By means of a silver knife, the portion of the sterno-thyroideus below the part divided may be dissected from its under surface, and the left vena innominata will be brought into view. The silver knife, also employed in like manner at the lower part of the wound on the right side, will expose the origin of the common carotid, along which the finger should be passed downwards. As the ligature is to be passed around the artery above the part crossed by the vena innominata, which is near its origin from the aorta, no great difficulty arises from its presence; yet it must always be recollected that cadaveric dissection gives a very imperfect idea of the size of veins actually engaged in the service of the circulation.

The artery being exposed by the cautious separation of the cellular tissue around it, the needle should be applied to its right side, as close as possible, for the purpose of avoiding the right vena innominata, and carried closely round the back of the artery, to avoid filaments of the cardiac nerves, one of which, however, descends on its anterior surface.

It is presumed that the reader is aware of the great irregularity attending the origin of the branches from the arch of the aorta. Should such irregularity prevail in the case under operation, the operation should still be carried on to its conclusion, as no ordinary variety would militate against it. If two vessels arose from the arch, instead of the single innominata, the ligature would necessarily be placed around the vessel pointing to the aneurism. If the middle thyroideal artery exist, it must be exposed during the operation. Should it appear to come from the innominata, a ligature should be passed around it. It does not, however, frequently exist at all, at

least not more than once in eight or ten persons, and then usually arises from the arch of the aorta.

The artery may be tied at a distance of a quarter of an inch from its bifurcation. The wound carefully cleansed of coagulum, if necessary, and the sternoid muscles replaced, may be united by suture, and adhesive plaster; one end of the ligature being brought out through it to the length of two or three inches.

For this operation four assistants are requisite; two of whom will be directly engaged in the operation. The instruments required are scalpels, forceps, a silver knife, a well-made and firm director, and a flexible director, two pairs of retractors, with handles of sufficient length to prevent the hands of the assistant from obstructing the movements and operations of the principal, and three or four kinds of aneurism needles, two kinds of ligature silk, the largest kind of which should be employed for the artery, and a finer ligature for any wounded vein, or minute arteries, should it be deemed requisite to tie them.

The greatest difficulty, I apprehend, in this operation, consists in the presence of the really large veins, forming a thyroideal plexus upon the trachea; one of which was divided in Dr. Mott's case, materially obstructing the progress of the operation. Should it be necessary to make the division of the origin of the sterno-mastoid muscle from the clavicle, as well as from the sternum, great care should be bestowed in the division, lest the transversalis colli vein be wounded. The division should be made slowly, from above downwards. A branch from the transversalis colli artery often enters the sterno-mastoid muscle near its origin.

OPERATIONS FOR TYING THE SUBCLAVIAN ARTERY.

From the summit of the arteria innominata, the right subclavian proceeds upwards and outwards, to the upper border of the first rib. On passing over the rib, it is covered by the scalenus anticus muscle. It then bends downwards, and at the lower border of the rib it receives the name of axillary. The first portion placed on the inner or tracheal side of the scalenus is about one inch in length; the second portion, or that behind the scalenus, about three-quarters of an inch; the third portion, or that on the outer side of the muscle, is also about an inch. The two subclavian arteries correspond in their course in the second and third stages, but not in the

first. On the right side the subclavian, in its first stage, rises obliquely, at an angle of about 45° to the vertical line. It is placed in front of the root of the right lung; it is crossed by the pneumogastric nerve; the right vena innominata descends in front but to the right side of it. The internal jugular vein crosses it, close to the scalenus. The first stage of the left subclavian artery is placed longitudinally, arising from the arch of the aorta; diverging a little from the left carotid, it ascends from behind the left pleura and lung, nearly in a vertical direction, having the corresponding pneumogastric nerve nearly parallel to it, and on its right side. The left vena innominata crosses, three or four lines in front of it, close to its origin from the aorta. Its length is about two inches.

In the second stage of their course, the subclavian arteries pass behind the scalenus anticus, on the front of which the phrenic nerve is closely adherent, descending along the line of the muscle into the chest. In the third stage, the subclavian vein lies close in front, but below the artery; and the axillary plexus of nerves is placed immediately above and behind it. The lowest branch of the plexus has been repeatedly tied, in place of the artery.

From the first or inner portion of the subclavian artery, there arise three large branches; viz. the thyroid axis, the vertebral and internal mammary. Two smaller vessels also arise from it when passing behind the scalenus; viz. the cervicalis profunda, and superior intercostal. Of these branches, the thyroid axis produces two secondary branches, the transversalis colli, and supra-scapular, which, crossing the scalenus muscle and phrenic nerve, enter and pass transversely across a triangular space, almost parallel to the main trunk. This small triangle is formed by the outer side of the scalenus, by the omo-hyoideus, and the base is completed by the first rib.

Aneurism of the subclavian artery is a rare disease, when compared either with that of the aorta or with that of the axillary artery. The part of the vessel least exempt from morbid changes is the third stage of the vessel, or that lying on the first rib. A pulsation is felt in this situation of a true aneurismal character, commencing clearly above the clavicle, and occupying the space between the clavicular border of the mastoid muscle and the anterior edge of the trapezius, influencing the circulation of the arm, so as to render the pulsation in all the vessels of the forearm more or less indistinct. As the disease advances, the aneurismal tumor

rises up in a conical form, projecting considerably above the level of the clavicle. The arm then becomes benumbed, and sensation is imperfect. The fingers are pale or livid, as the circulation becomes more and more interrupted, while the numbness in the limb is the result of pressure on the axillary plexus, lying side by side with the trunk of the artery.

In Mr. Colles's case the right subclavian artery was tied on the inner side of the scalenus, for aneurism of that artery beyond the scalenus. The operation was a protracted one. The ligature was not tightened till the fourth day. The patient died on the ninth. If the disease for which this operation was performed had been submitted to Mr. Colles's observation at an earlier stage, and before it had so largely encroached on the supra-clavicular region, he would have adopted the less complicated operation, and probably with a more successful result.

In operations upon the subclavian artery, judging from the almost unvaried failure that has followed the attempt to obliterate the artery, by applying a ligature around it on the inner or tracheal side of the scalenus muscle, it is of the utmost importance, in these cases of disease of the subclavian artery in its third stage, to tie the vessel on the outer side of the scalenus, before the tumor has reached a size sufficiently great to occupy the entire space up to the level of the scalenus muscle. Subclavian aneurism more frequently commences at a distance from that muscle, than close to it; and by an early operation, the artery may be secured on the external side of the muscle. Of late years the subclavian artery has been repeatedly tied with success for axillary aneurism, in which the disease occupies the higher part of the axillary cavity, extending upwards from the subclavicular into the supra-clavicular regions. The operation for tying the artery on the inner side of the scalenus corresponds so closely with that on the innominata, that further detail would be superfluous.

In aneurism of the innominata, the operation of Brasdor has been successfully revived by Mr. Wardrop.*

If the disease of the subclavian on the outer side of the scalenus do not encroach too closely on the muscle, an attempt may be made to tie the artery while passing behind it. This operation was suggested by Dupuytren, and requires an external incision, which will

* See Wardrop on Aneurism.

necessarily include the clavicular portion of the mastoid muscle. Its difficulty consists in dividing the scalenus without injury to the phrenic nerve, and the two arterial branches of the thyroid axis that cross this muscle. If this attempt be practicable, it is very preferable to the operations practised on the first stage of the subclavian, and most especially on the artery of the left side, which is one of the most—if not the most—difficult operations on the arterial system. I know of no case of its successful performance on record.

In 1809, the subclavian artery was first tied in St. Bartholomew's, by Mr. Ramsden, for axillary aneurism. Great difficulty presented itself in the attempt to turn the needle round the artery, consequent on the limited size of the wound, combined with its great depth. The patient lived five days, and died from exhaustion. In 1811, the artery was again tied for axillary aneurism, by Sir W. Blizard, without difficulty in passing the needle round the vessel. The subject died on the fourth day.

The first successful case occurred to Dr. Post of New York, who tied the subclavian artery for axillary aneurism, in 1817, and a second case in 1820; it was also successfully performed for the same disease by Mr. Liston. Within the last thirty years it has been performed, with a varied result, by many eminent surgeons, both in England and abroad, but in the aggregate of which, the ultimate recovery of the patient has not predominated.

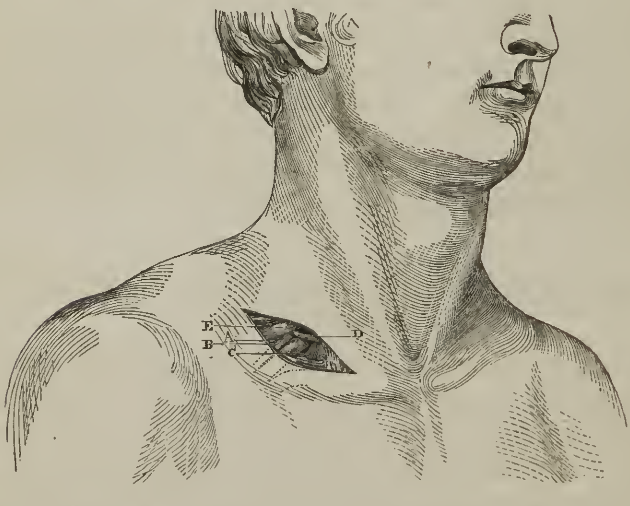
Operation for Tying the Subclavian Artery on the outer Side of the Scalenus Muscle.

The patient should be seated in a chair, reclining backwards. This position is so preferable to the horizontal one, that although nearly incompatible with the employment of chloroform, it should be adopted. If possible, the trunk of the patient should be in some manner further supported, to prevent the consequences of possible syncope. The abdomen should be fixed by a broad roller to the back of the chair. It is recommended that an incision be made from two to three inches along the line of the clavicle, the integuments over which should be forcibly drawn downwards by the left hand of the operator. When the tension is removed, the incision is found to occupy a line of about half an inch above the clavicle. Some difference of opinion appears to prevail on the necessity, or otherwise, of dividing the fibres of the mastoid muscle. Mr. Hodgson considers

this division will not facilitate the progress of the operation. Mr. Aston Key made this division, as he conceived with great advantage, on a case under operation. The truth is, that the necessity for dividing the fibres of this muscle will mainly depend on the extent of its attachment to the collar-bone. It is no infrequent occurrence, to find the mastoid and trapezius muscles investing almost the entire length of the bone, and I have repeatedly found the two muscles in contact nearly at its centre. Under similar relations the necessity for dividing not one only, but both these muscles, becomes indispensable ; and as a general rule in the performance of this operation, I confess I am inclined to differ from the opinion entertained by Mr. Hodgson on this subject.

The upper edge of the wound should be now raised, and the platysma completely divided. The edges should be drawn asunder and the base of the wound carefully dissected, and the strong fascia of

Fig. 27.



A. Subclavian artery.—B. Brachial plexus.—C. Scalenus anticus.—D. Transversalis colli. E. Omo-hyoid.

the region being divided, the omo-hyoideus will be brought into view at the upper part of the wound. The finger should now be applied for the purpose of ascertaining the exact locality of the artery, which is readily detected by its pulsation when felt; the cellular sheath around it may be carefully divided, and the parts rather torn asunder than cut. When this process is completed, the scalenus

muscle, the artery, and the lower branch of the axillary plexus will be brought into view. The nerve lies above the artery and the muscle internal to it. If the cellular tissue on the front of the scalenus be pressed inwards, the phrenic nerve will be exposed. The facility with which a ligature will be passed underneath the artery depends on two causes: first, the degree of elevation of the shoulder, consequent on the advanced stage of the disease of the axillary artery, and, second, on the dimensions of the wound. The first difficulty is a very large one, and to it, in some considerable degree, may be ascribed the length of time occupied, and the obstruction met with, by so many operators on this vessel. The artery lies at the bottom of a contracted wound, triangular in form, the apex of which is represented by the artery itself, and the base by the first incision, and of which the depth may be three inches or more. Under usual circumstances, when free from disease, the subclavian artery at this place lies one inch and a half from the surface, and if the length of the first incision be limited to the interval of the mastoid and trapezius muscles, the difficulty of passing a ligature around the artery must be great indeed. The records of past operations point, however, to a great variation in the degree of this difficulty. In Mr. Ramsden's case it was almost insuperable, and the same evil has beset the path of other surgeons, by whom, however, it has been met by improved mechanism, and by maturer preparation.

On the length of the outer wound, and on the means of making it of sufficient length, the surgeon should bestow his best attention. The narrow limits afforded to the operator by the above incision, have always presented to my own mind a positive objection to this form of operation, and a case requiring a ligature around the subclavian artery, in the year 1841, enabled me to test, on the living subject, the superiority of a different form of external incision. The incision I refer to, instead of being nearly parallel, is almost transverse in its relation to the artery, and renders any considerable division of the mastoid muscle needless. The incision is made in an arched form, and is commenced about two and a half or three inches above the clavicle, upon, or immediately on the outer edge of, the mastoid muscle. This incision is carried slightly outwards and downwards, towards the acromion, and then curved inwards, along the clavicular origin of the mastoid muscle. Its extent in the direction of the acromion must depend on the situation of the external jugular vein, the course of which varies in different individuals.

This vein crosses the mastoid muscle in an oblique course, downwards and outwards, and dips in behind the clavicle, at a distance from the outer border of the clavicular origin of the muscle, varying from half an inch to an inch and a half. It is desirable to avoid it, in either form of operation, although no evil has arisen from its division in that usually practised. Should the jugular descend along the outer border of the muscle, which is not common, either the vein must be divided, or the flap be dissected from off it. When the flap is reflected sufficiently inwards, with the platysma muscle, and the cervical fascia and cellular tissue separated, by being torn asunder, the subclavian artery is seen emerging from behind the scalenus and entering the triangle bounded by that muscle, the omo-hyoideus, and the first rib, and the lower branch of the axillary plexus and the transversalis colli are exposed to view. In this form of the outer wound, the difficulty of passing a ligature round the vessel is, I conceive, considerably lessened, in consequence of its direction being transverse to the course of the artery, and sufficient space is obtained for the introduction of the needle beneath the artery. A small portion of the clavicular origin of the mastoid muscle may be divided if necessary. The difficulty of the operation is but little increased, even supposing the interval between the mastoid and trapezius muscles to be limited, for the incision runs as it were parallel, rather than transversely, to them. I conceive, also, that benefit is obtained by an incision which does not involve the venous system of the parts divided, the evil of which, if not considerable as regards the question of loss of blood, is sufficiently great in reference to the necessary obstruction to the progress of the operation, by filling the wound with blood, and, assuredly, the vertical arched incision I recommend, has this advantage.

The above case of aneurism has not been published, and I proceed, therefore, to detail it from notes taken at the time, excluding such particulars as are irrelevant to my present purpose.

In the month of January, 1841, I was consulted by the Rev. Mr. P——, for numbness of the left hand and arm, which had existed for a period of about two months. He had observed it also to be more susceptible of cold than the opposite limb, and that it required the application of artificial warmth to enable him to use it while dressing. The hand was pale, more especially that part which is supplied by the median nerve, the little and ulnar half of the ring-finger being affected in a less degree. No pulsation was felt in the

radial artery. The brachial artery, especially at the lower part, beat languidly, and pain was felt in pressing the finger along the track of the vessels. Above the clavicle, just half way between the two extremities of the bone, I perceived a small tumor, pulsating synchronously with the heart, about the size of half a hen's egg. Its contents were partly fluid and partly solid. Pressure on the tumor reduced it greatly in size, and stopped the circulation in the brachial artery. I could trace the line of the trunk of the vessel above the tumor, to the extent of three-quarters of an inch upwards, to the scalenus muscles.

On the following day a consultation with Sir B. Brodie determined the necessity of an early operation, and in this opinion Mr. Travers also concurred.

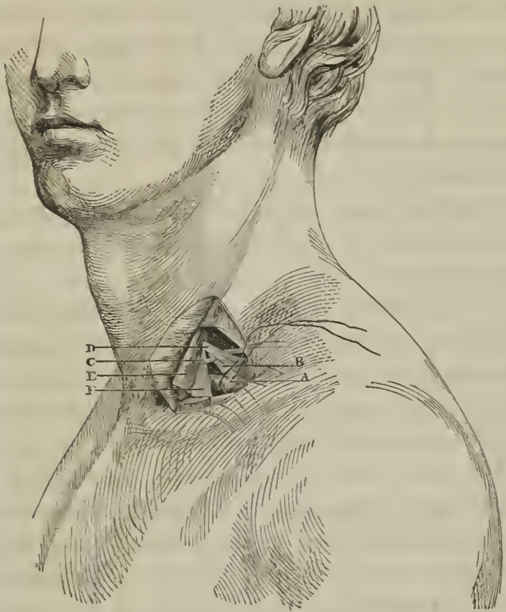
On Mr. P——'s return to town, after a necessary absence of four days, I found the tumor to have increased one-third in size, and the numbness in proportion, and it had encroached in the same degree on the trunk of the artery above. He suffered considerable pain along the side of the neck and arm, particularly when in a recumbent position. The peculiar situation of the aneurism, involving the portion of the vessel which lies on the lower edge of the first rib, and yet more subclavian than axillary, and the positive advance of all the symptoms during the short period of four days, determined me to perform the operation immediately; for I considered that, if deferred, sufficient space would not be left to apply the ligature with safety around the artery, without detaching or dividing the scalenus anticus muscle, a course I did not look upon with indifference, notwithstanding its recommendation by Baron Dupuytren.

I performed the operation on the 26th of January, assisted by Sir B. Brodie and other gentlemen.

I commenced an arched incision about three inches above the clavicle, close to the outer border of the sterno-mastoid muscle, and carried it a little outwards, curving it in towards the clavicular origin of the muscle, which I exposed to somewhat more than half its length. This flap, convex towards the acromion, I reflected inwards with the platysma muscle. A little careful dissection with a blunt silver knife exposed the lower belly of the omo-hyoideus muscle, and a portion of the sac, through the walls of which the pulsations of the artery were visible. On the inner side of the base of the wound, the external border of the scalenus was also exposed, and by tearing away the cellular tissue in this space, by means of a

blunt hook and a silver knife, the transversalis colli, and suprascapular arteries were brought distinctly into view, arising from the

Fig. 28.



A. Subclavian artery.—B. Brachial plexus.—C. Transversalis colli artery.—D. Omo-hyoid.—E. Sterno-mastoid, (reflected.)—F. Scalenus.

thyroid axis within the scalenus muscle, and proceeding outwards across the wound to their destination. Above the transversalis colli was felt the subclavian artery, and above the artery were seen the lower branches of the axillary plexus of nerves. The vein was not seen. I divided the cellular tissue covering the artery, fully exposed it, and found it perfectly healthy. Having slightly detached it from the rib, I had no difficulty in passing around it an armed needle, and encircling the vessel with a ligature at a quarter of an inch on the outer side of the scalenus. On pressing the artery at the situation of the ligature, all pulsation in the sac ceased: I then tied the thread. The operation was completed within ten minutes. The quantity of blood lost did not exceed one drachm.

Two hours after the operation, Mr. P—— complained of a sense of pain in the region of the sac, and of the ligature about the artery, and shooting pain towards the heart, and along the external

jugular vein, difficulty of swallowing, and pain down the inner side of the arm. The temperature of the limb was somewhat increased. Pulse during health 58, now 70. Two hours later, catching of the breath, with frequent sighing. Considerable difficulty of swallowing, as though caused by the presence of some body pressing upon the œsophagus, in the situation of the origin of the subclavian trunk from the aorta. This sensation he described most precisely. Pulse 84 and full.

These unpromising symptoms remitted under the influence of a large dose of nitre and tincture of henbane. His body was bedewed with perspiration, and his breathing became more regular. The temperature of the limb was still increased above the natural standard. He perspired copiously through the night, which was passed without sleep.

On the following night he was again attacked with difficulty both of breathing and of swallowing, and pain along the arm. I repeated the nitre and henbane. Bowels relieved by injection. On the third day he suffered from continued cough, with difficulty of breathing; his countenance was anxious; his sense of weakness was very great. Tincture of henbane one drachm. On the fourth day had slept for three hours. Cough. Had awaked with nightmare, and a tingling sensation in the left hand. He was now placed on a water bed, to which may be attributed a severe attack of general rheumatism, accompanied by pains about the loins and sacrum, and shooting pains down the legs. Colchicum and Dover's powder prostrated him. His urine became very high-colored and scanty. He was removed on to a feather bed. The wound had healed by the eighth day. These symptoms were followed by a painful attack of chronic phlebitis of the left leg and thigh, and the foot became large from œdema. This disease affected the saphena, major and minor, the femoral, and even the external iliac vein, and was, at its height, so severe as to create some alarm in my mind as to my patient's recovery.

I excoriated the surface with hot water over the track of the vessels, and rubbed in an ointment, composed of one drachm of unguentum hydrargyri, and twenty grains of extract of opium. He took internally two grains of calomel, and one-eighth of a grain of morphia. This I repeated each night, rolling the thigh in flannel.

This treatment proved successful, and at the expiration of a week

he had lost all sense of tenderness over the veins, and the œdema subsided.

On the thirty-second day Mr. P. complained of pain in the left arm, and I observed the basilic vein to be the seat of the same disease as had attacked the veins of the leg. I treated it with the blue ointment and opium, and with the same success.

In the mean time the sac became greatly reduced in size, and the hand had regained its sensibility and its temperature. The ligature continued firm; but though unwilling to employ any kind of force, I drew it obliquely in all directions, and wound it around a small roller of plaster. I felt satisfied that it was not detached from the old vessel, because it rose and fell with the first rib in every act of respiration.

I removed it on the forty-seventh day, without force, and without the escape of a drop of blood. The depth of the wound, as indicated by the length of the ligature, was one inch and an eighth. The pulsation in the radial artery returned on the fifty-first day. At the present date, which is nine years after the operation, Mr. P. has had no return of disease, and is in possession of good health.

Many forms of needle have been invented by surgeons, as well as by instrument makers, to obviate the occasional difficulty of passing the thread around the subclavian, and other arteries. That which I employed in the above case was a modification of the needle recommended by Mr. Alcock, in which the curved part is made spiral, not unlike the form of a portion of a corkscrew. *See* page 186.

It is of the utmost importance that the artery be clearly exposed to the view, not only of the operator, but of his assistants. Unfortunately the lowest branch of the axillary plexus, which lies in immediate contiguity with the artery, when it has passed the scalenus, has been mistaken for the vessel, on more than one occasion, and tied. In Mr. Liston's first case this accident had nearly occurred. The ligature was applied around what appeared to be the artery, but on pressing the object it did not control the pulsation in the sac. This led to further observation, which detected the error, and the ligature was removed.

In all such cases the operation has proved fatal.

OPERATION FOR TYING THE AXILLARY ARTERY.

From the lower border of the first rib to the inferior margin of

the tendon of the latissimus dorsi, the main arterial trunk of the upper extremity takes the name of *axillary*, from the cavity through which it passes. Its length is about five inches. In its upper half it lies deeply under cover of the pectoralis major and minor muscles. In its lower half it takes the direction of the humerus, lying along the outer side of the axillary cavity. On leaving the lower border of the first rib, the artery is covered by the pectoralis major and an expanse of fascia, which descends transversely outwards from the first rib to the coracoid process, called the costo-coracoid ligament. The vessel here lies on the first digitation of the serratus magnus. Pursuing a course of about an inch and a half, it passes in an oblique direction underneath the pectoralis minor, within about one inch of its insertion into the coracoid process. The breadth of the muscle is, at this part, about an inch and a quarter. Leaving the pectoralis minor, the artery is again covered by the pectoralis major, and lies in the hollow of the axilla, across the apex of which it passes, while surrounded by the axillary plexus of nerves. Reaching the outer or humeral side of the axilla, it lies on the subscapularis muscle, by which it is separated from the head of the humerus. Descending, it is placed on the latissimus dorsi, to its termination in the brachial artery. In the upper half of its course, it is only accessible to the surgeon by a division of the pectoralis major muscle; in the lower half, it may be exposed in the axillary cavity.

Throughout its entire length the axillary vein lies anterior and internal to it, if exposed on the dead subject, but in the living body the veins are so greatly distended, and so irregular in their course and distribution, that a considerable portion of this vein will be placed partly in front of the artery. In the lower or axillary portion, the artery is surrounded with veins of large size, the thoracic and subscapular, which cross it in various parts of its course.

One or two thoracic nerves, from the upper part of the plexus, cross the axillary artery, in the first part of its course, immediately below the clavicle; and while in the axilla, the vessel is surrounded by the axillary plexus of nerves, at the lower part of which the median nerve lies nearly in front of it. This nerve is formed by a double root, the outer of which it receives in common with the external cutaneous nerve, while the inner is derived, in common with the ulnar and cutaneous, from a separate root of the axillary plexus. The depth of this artery below the skin in its upper half is about one inch and a-half.

On Aneurism of the Axillary Artery.

Next in liability to the popliteal, the axillary artery is the subject of aneurismal disease. The occult nature of the cause and the general occurrence of aneurism of this vessel in the lower classes of society, will explain why such patients rarely resort to medical assistance before the disease has made considerable progress. Disease of the vessel is denoted by the usual symptoms affecting the circulation of the extremity. An aneurismal tumor forms, which interrupts the free current of the blood through the part of the vessel below it. Pulsation in the radial and ulnar arteries is indistinct, or at least is reduced in strength, when compared with that of the opposite limb.

The presence of the aneurism is denoted by a tumor of very uncertain dimensions, occupying any part of the length of the axillary trunk. If it commence in the first part of the vessel, the tumor will present itself behind the pectoralis major muscle, which is pushed forward in a diffused swelling, pulsating synchronously with the heart and general arterial system. This swelling will be very perceptible by examination in the axilla. On the other hand, the lower stage of the artery may be the seat of its disease, when the tumor will occupy the axillary cavity, and acquire a considerable magnitude before it has produced any material change in the form of the pectoral muscle. Under either of the above conditions, should the tumor become large, but more especially in disease in the first part of its course, the shoulder is forced upwards by the increasing swelling. It is by this elevation of the clavicle that the subclavian artery is rendered so difficult of exposure. The proximity of the artery to the plexus of nerves supplying the upper extremity causes numbness of the limb, by pressure on the plexus. In cases of advanced disease, it is important, in forming an opinion as to the locality of the origin and seat of the aneurism, to ascertain the date of the numbness, whether it was an early or a late attendant on the disease. If early, it is most probable that the lower part of the vessel was first involved, and more especially so, if a portion of the limb only became at first affected, such as the parts supplied by the median or ulnar nerve, to the exclusion of the remainder of the hand or arm.

If, on the other hand, the numbness followed at the expiration of

some weeks from the first appearance of the disease, and the shoulder became elevated prior to the occurrence of numbness, and the pectoral muscle be elevated and prominent, then, in all probability, we shall correctly infer that the upper portion of the vessel is the seat of the aneurism. In this latter case, the altered relation of the clavicle is not the only consideration, for we must keep in mind the possibility of the disease having so far encroached on the subclavian artery itself as to prepare us for the necessity of exposing the vessel behind the scalenus, or even on its inner side.

The axillary may be tied in any one of three parts of its course, either above the tendon of the pectoralis minor, below that tendon, or when lying in the lower part of the axilla, on the insertions of the subscapularis or latissimus dorsi muscles. In looking at the relations of the trunk of the subclavian, on the outer side of the scalenus muscle and the axillary artery, lying underneath the thick mass, comprising the subcutaneous fat and the pectoral muscles, there cannot be much hesitation in selecting the former as the seat of operation. Contrasting the superficial position of the freedom from complicated relations of the subclavian, with the depth of the axillary artery in this situation, shut out from judicious surgery by an investment of a large and solid muscular mass, an extensive division of which is indispensable to its exposure, we can only refer its selection for operation in the cases in which it has been resorted to, to the uncertainty that prevailed, at the date of these operations, as to an adequate supply of blood to the extremity. It is an operation greatly to be deprecated, and only justifiable in cases of wounds involving the axillary trunk, or its primary branches.

The axillary artery may be exposed by an incision commenced about two inches from the sternum, and almost directly below the clavicle, and carried outwards, either in a line slightly arching downwards, or in a straight line obliquely outwards and downwards to the extent of from four to five inches. If carried too far, the cephalic vein, ascending between the pectoralis major and deltoid muscles, may be unnecessarily divided.

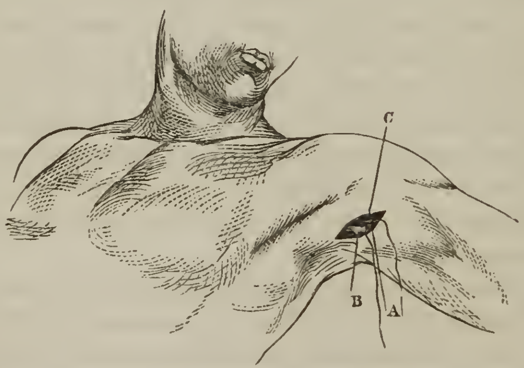
The line being clearly determined on, the patient should be placed nearly horizontal, with the affected arm extended for the purpose of rendering the pectoral muscle tense. The muscle should be divided nearly to the same extent as the external incision. The wound should be kept as free from blood as possible, either by active sponging, or by waiting for a few minutes, until the hemorrhage

has ceased spontaneously. The cellular tissue, or the fascia covering the artery, which is thickest in the first stage of the vessel, should be removed by a blunt silver knife, or torn asunder. The artery may then be readily exposed, either above or below the tendon of the pectoralis minor, on bringing the arm to the side by which the fibres of the pectoralis major are relaxed.

The needle should be placed around the vessel from below upwards, in order to avoid the axillary vein. Of its branches, the thoracic axis, supplying the short thoracic, the acromial, and the humeral thoracic, is given off above the pectoralis minor, and the long thoracic behind, or immediately below that muscle. The artery being tied, the arm should be brought and fixed to the side, and the outer wounds united by suture.

For aneurismal disease of the brachial artery, the axillary trunk may be tied in the axilla, both with less difficulty, as well as less danger to the patient. For this purpose the trunk of the patient should be placed quite horizontally, with the head raised on a pillow. An incision, very oblique to the previously ascertained course of the vessel should be made, to the extent of about two inches and a half, on the tendons of the subscapularis and latissimus dorsi muscles, in the fullest extension of the arm, which should also be rotated outwards as much as possible. This incision should involve the skin only, in consequence of the superficial position of the artery. It should be kept in mind that the artery is here surrounded with

Fig. 29.



A. Artery.—B. Vein.—C. Axillary plexus.

nerves, and that the axillary vein overlaps it on its inner side or that next the chest, into which many secondary veins of considerable

size may pour their contents. An assistant should hook up as much as possible of the anterior margin of the axilla. The sheath of the vessels and nerves being exposed, the scalpel should be laid aside, and a silver knife employed. The forearm should be bent for the purpose of relaxing the vessels. The nerves should be separated by the careful manipulation of the operator, who would endeavor to avoid exposing the artery when crossed by a large branch of a vein. It may be tied between the roots of the median nerve; but care should be taken not to include the nerves in the forceps, but to draw them aside with a blunt hook. The ligature should be passed around the artery, from within outwards, the wound united by two sutures, and the arm extended on a pillow, when the patient is placed in bed.

OPERATION FOR TYING THE BRACHIAL ARTERY.

The main arterial trunk of the upper extremity receives the name of brachial, from the lower border of the latissimus dorsi muscle to the division of the vessel into its secondary branches, at the bend of the elbow. In the whole of this course, the artery lies so superficially that its pulsations may be felt on pressure. It pursues a straight course downwards, along the inner side of the biceps muscle, and inclining, at the lower third of the arm, to its front surface. It is placed respectively on the triceps, coraco-brachialis, and brachialis anticus muscles, being overlapped in the early part of its course to the extent of about two or three inches of its length, by the coraco-brachialis, and then by the fleshy belly of the biceps muscle. As this muscle contracts in breadth on reaching the elbow, the artery inclines forwards upon the brachialis muscle. In the whole of the above course, the brachial artery is in close apposition with two or more veins, and with the median nerve, this close relationship being retained by a layer of tolerably dense fascia, derived from the biceps muscle, and from the cellular tissue condensed around. Two considerable branches, the superior and inferior profunda, are given off in the first two or three inches of the course of the vessel. The veins are usually three in number, two of which only are in immediate relation to the artery, and are derived from the venæ comites of the forearm. All the arterial system of this region is provided with venæ comites, radial, ulnar, and interosseous, and even their secondary branches. At the bend of the elbow these

numerous veins unite to form the two companion veins of the brachial artery, which proceed up the arm, having occasional branches of communication across the artery, either before or behind the vessel. Great irregularity prevails in their extent. Usually they are joined by the basilic vein, which, lying upon the fascia of the forearm, becomes, like the venæ comites, a deep-seated vein on reaching the elbow. The basilic vein lies on the inner side of the brachial artery, at the bend of the elbow, generally at a distance of half an inch, and gradually approaches the artery in the upper part of the arm, where it is joined by one or by both the lesser veins, above described. The basilic or brachial vein here lies on the artery; occasionally the venæ comites unite immediately above the elbow into a single trunk, or one may join the basilic in the middle third of the arm.

At the commencement of the brachial artery, the median nerve lies to the outer side, and a little in front of the artery, whence it pursues a straight line downwards, gradually crossing the artery to its inner side, where it is always situated at the bend of the elbow. Considering the breadth of the artery and the nerve, these two objects must always hold a relation of proximity in more than three-fourths of their course. The median nerve crosses over the artery, as a general rule, lying between it and the skin; in about one example in six, the nerve passes underneath the brachial artery. In the upper third, the internal cutaneous nerve lies to the inner side of the artery, and may be readily exposed in the operation for tying the vessel in this situation.

Irregularities in the course of and division of the brachial artery are comparatively common; and before entering on the operation for tying this vessel, it is very desirable that a general survey of the arm be made, with a view to detect, if possible, the presence of any variety that may exist, or any departure from the general course and distribution of the vessel or its branches.

The chief irregularities to which the brachial artery or its branches are subject, are—first, a common origin of the superior profunda with the posterior circumflex. It may be detected by its size, being less than one-third of that of the main trunk, and could never be mistaken by any surgeon who is competent to attempt the operation for tying the brachial. Moreover, pressure on this lesser vessel would fail to arrest pulsation in the sac; and this fact, coupled with the internal position of the artery, would always raise the question of its identity. Second, a high division of the brachial into the

radial and ulnar arteries; the two vessels being parallel, and in close apposition to each other. Either the radial or the ulnar may be given off from the main trunk of the brachial. Of these two varieties, the high origin of the radial is by far the most frequent. These two varieties are not identical. Under these circumstances, it descends along the arm, nearly in contact with the brachial, becomes superficial at the bend of the elbow, and descends immediately beneath the fascia to its destination in the hand. Other still rarer varieties occasionally present themselves to the anatomist.

On Aneurism and Injuries of the Brachial Artery.

True aneurism of the brachial artery is a very rare occurrence. In considering the size and importance of this vessel, it may be asserted with truth, that no artery in the whole system is less liable than the brachial to the occurrence of the kind of disease of which other arteries are the subject. Cases, however, are recorded. One example is related by M. Lisfranc of the existence of several aneurisms having occurred in the brachial artery of an individual.

The brachial artery is usually tied for *traumatic* aneurism, caused by puncture during the operation of bleeding, by which the vein is transfixed, and the artery wounded by the point of the lancet. This occurrence is not an infrequent one in surgical practice. A healthy artery is wounded, and the blood escapes from the vessel in quantity proportioned to the size of the puncture, which being necessarily small, and the opening direct with the outer wound, the arterial blood mixes with that larger quantity flowing from the vein, and it is probably not observed by the inexperienced operator. Pressure is made on the wound common to the puncture in the two vessels, and with force proportioned to the difficulty in arresting the current. The oozing of the blood from the artery continues during the application of the pressure; on removing which, at the expiration of forty-eight hours or less, a small tumor may be observed to occupy the situation of the puncture, which pulsates synchronously with the arterial system.

The vein may lie in direct contact with the artery, or at some lines distant from it. The wound in the opposite wall of the vein may heal, or it may remain patent; and under this latter condition, the arterial blood will continue to enter the vein. I remember, some years since, to have seen a man, in whom the operation of venesec-

tion had been performed with the above result. The aperture in the artery was considerable, but the outer wound healed. So considerable a quantity of arterial blood continued to escape from the artery, and flow into the vein, as to render the cutaneous venous system largely varicose. A thrill was observed, at the distance of many feet from the arm, which was considerably reduced in bulk, and its muscles equally so in strength and efficiency.

To these varieties of injury the inappropriate names of *aneurismal varix* and *varicose aneurism* have been applied. It must be obvious, that the term aneurism is inapplicable to this condition of the vascular system of the part, and that it can only be employed when qualified by the word *traumatic*.

Many weeks or months may elapse without any extension of the injury; or, as occasionally occurs, the blood may escape from the cavity by which it has been circumscribed, and become diffused throughout the cellular structure of the limb. In the year 1842, I tied the brachial artery for a medical friend, whose son had punctured the vessel in venesection, in which the sac, as usually formed, gave way at the expiration of a fortnight, and the blood became largely diffused throughout the limb.

As regards the material of which the sac is composed, it is probably the product of the common cellular tissue around the artery, although it has been a question much canvassed. Scarpa has referred it to the intermuscular ligamentous or fascial tissue, prolonged from the coraco-brachialis muscle, and extending downwards to the internal condyle; but as this structure is found only on the inner side of the artery, and extends upwards for some inches in length, and as the tumor is mostly rounded in form, and is confined to the exact locality of the puncture into the artery, the explanation does not appear very satisfactory. That it is not formed by the fascial expansion of the tendon of the biceps must be equally obvious, from the fact that the wound in the artery is generally higher up the arm.

The comparatively small size which these traumatic aneurisms acquire after venesection may be referred to the pressure of the pad and bandage, applied immediately on their occurrence, rather than to any peculiarity of local structure. The pressure is applied more positively than usual, consequent on the greater difficulty of arresting the bleeding.

The operation employed for the cure of this form of traumatic aneurism is an exception to a general rule, which prescribes a double

ligature to be applied above and below any open wound through the coats of an artery from which the blood escapes. And the exception is, at first sight, a sound one, because, although in this example the blood does escape from the artery, yet it does not infiltrate the cellular membrane of the limb, but is as fully circumscribed by the sac as it would be by the dilated coats of the vessel itself in true dilatation; and this fact brings it under the treatment due to circumscribed aneurisms in general. If there be any ascertained tendency in the sac to yield, then the double ligature must be resorted to, as the only safeguard against secondary hemorrhage.

When it is ascertained that pressure on the brachial trunk commands the pulsations of the sac, that artery may be tied in any part of its course above the tumor, and is commonly tied for the cure of this injury; but this fact is not very easily ascertained, consequent on the contiguity of the artery, be it radial or ulnar, to the main trunk, which the experience of the dissecting room exhibits as a frequent deviation from the regular distribution of the vessels of the upper arm. The pressure of the finger would probably, therefore, involve both vessels. This inquiry should be followed by a careful examination of the forearm, where the irregularity in the course of either radial or ulnar artery might be detected; more especially that of the former, which frequently, under these circumstances, pursues a superficial relation to the muscles down the limb. No examination, however carefully made, can detect with certainty the variety that may really exist, and although a high division of the brachial artery into two vessels of very unequal size, or a high origin of the inferior profunda would, when exposed, rarely lead to failure in the hands of a careful operator, yet the means of judging by the exposure of these vessels infers a false step already taken. If to this evidence we add that of the occasional failure of the Hunterian operation in traumatic aneurism of the brachial artery, it may become a question whether the operation of opening the sac, and applying two ligatures around the artery is not, in the end, the more safe and the more perfect means of cure. The Hunterian operation for aneurism is resorted to in cases of traumatic puncture of the brachial artery, because it is deemed a simpler operation than that which has for its object the exposure by dissection through the sac of the punctured vessel; and it is fully justified by the circumscribing operation of the sac, which, whether formed by a true aneurismal process of dilating one or more of the coats of the vessel,

or by a condensation of the cellular membrane around the artery, equally prevents an escape of the blood into the general cellular tissue of the limb, so long as it continues perfect.

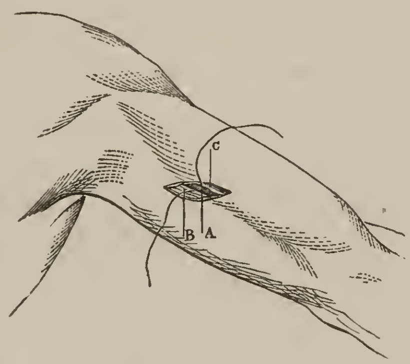
But the results attending this operation are not so invariably successful as to justify its performance without careful examination and inquiry; and I doubt whether, under all circumstances, the exposure of the artery at the point of injury is not the preferable course for adoption, because the most certain in its result. The chief ground of preference to be given to the Hunterian operation of tying the brachial artery at any distance above the elbow-joint, is the greater simplicity of the undertaking. I am inclined to question the force of this argument. The brachial artery, notwithstanding its superficial position in the limb, is surrounded by important structures; and simple as the operation appears, I have never seen it completed in the hands of practised operators within a period of from a quarter of an hour to twenty minutes, or longer; and on one occasion, when performed by so experienced an operator as the late Baron Dupuytren, half an hour, no very unusual period for this operation, was required. There cannot be a doubt, I imagine, the question of time and difficulty being laid aside, that a surgeon would feel better satisfied in having entirely cut off the disease by the application of the double ligature, than by having applied a single ligature to the artery for the treatment of a disease, the cure of which is yet to be completed; and I doubt whether, comparing the two operations together, that of exposing the wound in the vessel can be deemed the more difficult of the two, while it is undeniably more certain in its results. Having performed both on more than one occasion, I do not hesitate in giving the preference to the operation at the seat of injury.

Operations for Tying the Brachial Artery.

The arm should be widely extended from the body, and supported on a firm table, and should be held in rotation outwards as much as possible, without giving pain. The surgeon, if about to operate on the right arm, should stand at or below the elbow of the patient; if on the left arm, it will be more convenient in operating with the right hand, if he stand at his shoulder. The artery may be exposed in any part of its course with nearly equal facility; but it is desirable, when the operation is performed for the cure of traumatic

aneurism, that it be exposed and tied at some little distance only above the injury ; for, however well established may be our convictions on the subject of inosculation, yet there is no advantage to be derived from cutting off the collateral channels of future supply; and we have here no disease of the arterial coats demanding distance between the ligature and the sac. Again, in the middle of the arm, the artery is often greatly overlapped by the biceps muscle, and is generally covered by the median nerve; therefore we may select the upper part of the inferior third of the arm, as the most unobjectionable for the operation. An incision of about two inches in length, carried across the artery in *an oblique* direction, at about an angle of 35° or 40° with it, will expose the fascia covering the vessel. Care should be taken to avoid the basilic vein, the course

Fig. 30.



A. Artery.—B. Vena Comes.—C. Median nerve.

and situation of which should be previously noted, if possible. The fascia may be rendered tense by the pressure of the fingers of an assistant on the biceps muscle, or by drawing the muscle outwards, taking care that he does not drag on the wound in the integuments. The fascia may be divided on a director, or without one, to the extent of about an inch, when the pulsations of the artery will be distinctly felt by the finger. All that is now required is to separate the median nerve and the venæ comites from the artery, and this is effected more safely by means of a silver knife. The ligature may be carried round the vessel from within outwards, or vice versâ, it is of little importance which ; probably the greater magnitude of one of the venæ comites, and that more commonly the

internal one, may determine the question, if any arise; a matter of choice which rarely merits the importance attached to it. If, in exposing the trunk of the artery, the origin of the anastomotic branch be brought into view, the ligature should be applied around the artery above its origin, and not below it.

If the operation be performed in the middle of the arm, it will be recollected that the median nerve lies in this situation upon the artery. It should be drawn to either side with a blunt hook. More care in dissecting on the vessel will be required from the larger size of the venæ comites, which increase in magnitude as they ascend, by the junction of the muscular branches of the arm. In the upper third, attention should be paid to the origin of the inferior, and even to the possible exposure of the origin of the superior profunda. In this situation the median nerve would of course be drawn outwards. If in either of these operations a second artery of size were exposed, the relation of either one to the sac should be ascertained by pressure before passing the needle underneath it, and the other vessel be left untouched.

In the operation for obliterating the brachial artery at the point of injury, at the bend of the elbow, the arm should be placed as in the former operations, and the forearm supinated; a tourniquet should be applied to the artery, in the middle of the upper arm, or the artery pressed by the fingers of an assistant. The course of the biceps tendon should be ascertained, and an incision longitudinal in direction, should be made in the integuments over the sac, to the extent of about two inches and a half, or less. This incision will probably divide the vein, which was transfixed at the former operation. This, however, is an evil of slight moment, if of any; for the vein will be more or less obliterated by the diseased actions which have been carried on underneath it. Of course it is not advisable to divide the vein, if it can be avoided without adding to the difficulty of the operation, by giving a false direction to the first incision. The sac should be opened with some care, and the blood contained within it, partly fluid and partly coagulated, should be removed by a small piece of soft sponge, or, if necessary, carefully scraped away, or separated with the handle of the scalpel. If requisite, the sac may now be yet more fully divided, and the finger applied to the bottom of the cavity, to ascertain the degree of proximity of the wounded vessel. Probably at this stage the wound may be brought into view, although the artery may require a little more dissection

to expose it in length sufficient to enable the surgeon to apply a ligature both above and below the aperture, which will generally be found considerable in size, when compared to the wound orginally made in its coats. It is better to introduce the aneurism needle a second time, and apply the ligature singly, than to pass a double thread around the artery and attempt to draw them asunder. In other words, the artery should be as little disturbed as possible in its relation to the surrounding parts. It is very desirable, in this operation, to avoid the fascial expansion of the biceps muscle. By its division in those cases especially in which the sac has partially burst, and the blood become diffused throughout the limb, the healing process is often protracted for many weeks, and contraction of the arm, by permanent flexion of the elbow-joint, has followed. Under all circumstances, this operation on the artery at the elbow-joint should be done carefully, and with as little violence to the exposed parts as possible.

ON THE OPERATIONS FOR TYING THE RADIAL AND ULNAR ARTERIES.

The radial artery pursues nearly a straight direction from its origin on the inner side of the tendon of the biceps muscle to the radial side of the forearm, where the pulse is usually felt. But this general knowledge would prove insufficient to the surgeon in cases of difficulty; we should know its relation to the muscles of the forearm. Throughout the whole of its course to the root of the thumb, the radial artery is uncovered by muscles crossing it, although it is partly overlapped by several. In supination of the hand, the radial artery crosses the tendon of the biceps muscle; in descending it lies between the mass of muscle covering the head of the radius, of which the supinator longus is the most prominent, and the mesial or inner muscle, from the mass arising from the internal condyle, viz. the pronator teres. Passing downwards over the insertion of the pronator teres into the radius, it lies between the flexor carpi radialis and the long supinator, resting on the deep fibres of the flexor sublimis digitorum, and on the flexor pollicis. It is accompanied in the whole of its course by two venæ comites, and it holds the relation of near proximity, in the first two inches of its course, with the branches of the radial nerve. In the rest of its course, the

radial nerve is sufficiently to its outer side to render farther allusion to it unnecessary.

The ulnar artery commences from the same point as the radial, and is formed with it by the subdivision of the brachial. Its course is obliquely inwards. It occupies the upper half of the forearm in passing underneath the four superficial muscles, arising from the inner condyle, and about midway between the elbow and wrist joints, the ulnar artery lies, uncovered by muscle, on the flexor profundus, having emerged from the mass which has crossed it in its descent. In this situation the ulnar artery lies about three-quarters of an inch from the inner surface of the arm. In the last two or three inches of its course, and before passing over the annular ligament, it is overlapped by the tendon of the flexor carpi ulnaris. If the muscles of the forearm are unusually large, the inner tendon of the flexor sublimis will be in so close contact with the flexor ulnaris, that the artery is covered to within four inches of the wrist. Both radial and ulnar arteries are covered by a dense fascia, produced from the deep-seated muscles and bones.

Fig. 31.

Fig. 32.

Ordinary aneurism of either of these vessels is almost unknown, but operations are not infrequently required for tying them in cases of wounds. The line of each vessel may be determined with sufficient precision to enable the operator, if not very familiar with the detail of their anatomy, to expose them without much difficulty. The radial artery may be exposed by an oblique external incision, the centre of which would cross any part of the line drawn from the middle of the arm at the elbow-joint to the line of the pulse, and the ulnar, by an oblique external incision across its course, indicated by a line drawn from the centre of the elbow, obliquely inwards, to half-way down the arm, the termination of its course inwards being one inch from the inner surface of the arm. In the rest of its course, it passes longitudinally to the inner side of the os pisiforme.

Supposing the ulnar artery wounded in the upper part of the forearm, when covered by the thick fleshy mass of muscle from the inner condyle, the operation is a difficult one. I cannot subscribe to the opinion of Mr. Guthrie, advocated in his work on "Injuries of Arteries," who suggests the necessity of dividing the muscles across, avoiding the median nerve. If this dissection be indispensable, I should greatly prefer a longitudinal incision, through both integuments and muscles, till the artery be exposed underneath them. If the puncture were low down in the mass of flexors, it would be more prudent to separate the flexor sublimis from the flexor carpi ulnaris, as high as possible, by exposing the artery from below upwards; and but for the origin of the interosseous branch, I should prefer to tie the ulnar artery before it passes underneath the muscles, and again on its emergence from them, to a transverse section of the muscles themselves, as recommended even by the high authority of Mr. Guthrie.

For all wounds of the radial or ulnar arteries in the palm of the hand, the trunks of these two vessels should be tied above the wrist. When the superficial palmar arch is divided, the vessel retracts so much, and the structure of the palm is so elaborate and so important to the functions of the hand, that any attempt to seize the divided ends of the artery would be both futile and injurious.

I remember to have seen this attempt made by an experienced surgeon, who, after a lengthened effort, was compelled to desist and to tie the two vessels above the wrist. In all wounds of the larger arteries of the hand, both radial and ulnar artery must be tied, consequent on the frequent inosculations that exist between them.

In wounds of the radial artery, after it has passed underneath the extensor tendons of the thumb, the recurrent flow of blood from the

Fig. 33.

palm is nearly as large as the direct one, and the same remark will apply to wounds of the superficial or ulnar arch. In all such wounds, therefore, the two vessels should be secured. The radial artery may be exposed about two inches above the wrist, for the purpose of cutting off the direct supply to the superficialis volæ. The artery is readily exposed by means of an oblique incision across it, the fascia being then divided. A fine ligature may be passed behind it, including the venæ comites, if their separation from the artery be found difficult. The ulnar artery is exposed with a little more difficulty. The oblique incision being made at one inch distance above the wrist, the hand should be bent forwards, in order to relax the tendon of the flexor ulnaris, underneath which the artery will be found. During the dissection, the hand may also be bent backwards, which, by rendering the flexor carpi ulnaris tense, will push out the ulnar artery from behind it.

The radial artery behind the thumb may be exposed by an incision across the proximal ends of the metacarpal bones of the thumb and forefinger, beginning close to the outer side of the tendon of the extensor secundi internodii pollicis, and for which the length of about one inch would suffice. It is necessary to keep this relation in view, or difficulty will be experienced in finding the vessel.

Fig. 34.

Such is the result of my own, and the yet more extended experience of my late friend and instructor, Mr. Abernethy. A dozen cases I have succeeded in at least. In one case only did some trickling of blood recur. In the hands of my late colleague, Mr. Vincent, this practice did not prove equally successful. His impression is that a ligature on the radial and ulnar arteries will not suffice to arrest hemorrhage in all cases. He recommends the application of firm pressure on the palm ; and should this remedy fail, he would advise resort to a ligature around the brachial artery. In this view, also, I believe Mr. Liston concurred.

ON THE OPERATION FOR TYING THE PRIMITIVE OR COMMON CAROTID.

The common carotid emerges from the chest, behind the sterno-mastoid muscle, and proceeding upwards by the side of the trachea, it divides into its secondary branches opposite the upper border of the thyroid cartilage. In the early part of its course it is deeply placed, lying underneath the sterno-mastoid and sterno-hyoid and thyroid muscles. As it ascends, it becomes more superficial, covered only by the platysma and fascia of the neck. In the first part of the course the artery is unsupported; in the middle of the neck it lies on the rectus anticus and longus colli muscles, which separate it from the vertebral column. The right carotid, arising from the innominata, is somewhat larger than the left. It is also shorter, by reason of its origin from the innominata, and is placed a little anterior to the plane of that on the left side, in the lower part of its course. The left carotid, arising from the aorta, is of course longer, and it is not quite so close to the trachea in the early part of its course. An important difference of relation to the internal jugular vein on each side prevails, caused by the venous current being directed towards the right side of the heart ; viz., that while

the internal jugular of the right side, in its descent, diverges from the outer side of the artery, and leaves a space of more than half an inch between these vessels, that of the left side, slightly curving towards the mesial line of the neck, is placed considerably upon the carotid of its own side, rendering more difficult the attempt to expose the carotid on the left than that on the right side at the lower part of the neck. At a distance of about two inches above the clavicle, the carotid artery is crossed obliquely by the omo-hyoideus muscle, passing upwards from its origin in the scapula to the os hyoides. In the lower part of its course, the common carotid holds important relations with the surrounding structures. It is connected by a dense sheath to the jugular vein; on the front lies the descendens noni nerve, for the supply of the muscles called the depressors of the os hyoides. The course of this nerve is oblique from without inwards. The inferior thyroid artery crosses behind the trunk of the carotid, and on the inner side ascends the recurrent laryngeal nerve. On the left side of the neck, the thoracic duct curves forwards from the inner side of the artery, to empty its contents into the subclavian vein. The pneumogastric nerve, and the trunk of the sympathetic, and many filaments proceeding from it to join the cardiac plexus, are found behind the carotid trunk.

In the upper part or division of the carotid, the relations are more simple. The artery lies underneath the anterior margin of the sterno-mastoid muscle, having freed itself from the contact of the sterno-hyoid and thyroid. It here holds nearly the same relation to the vein on either side. It is covered by the edge of the mastoid muscle, and by the cervical fascia only, and its current of blood may be here arrested by pressure by the finger against the spinal column. In both of these two stages of the carotid, the artery is crossed by one or more veins of considerable size, proceeding outwards from the thyroid body. The lower branches often form a considerable plexus in front of the artery, where it emerges from the chest; the upper branches corresponding with the superior thyroid artery, cross the trunk, above the omo-hyoid muscle, and empty themselves into the internal jugular vein. These veins may present a considerable obstacle to the easy passage of a ligature around the artery in either division of its course, if the sheath be unfortunately opened immediately in front of them.

On Aneurism of the common Carotid Artery.

Aneurism of the common carotid artery is not a common disease, although it is frequently suspected to exist by hasty observers. The real disease presents a diffused tumor, occupying the middle of the lateral aspect of the neck, along the line of the artery, and pulsating synchronously with the arterial system. But this is not sufficient. The evidence of arterial disease must be most carefully examined. A tumor on the carotid trunk, occupying the middle of the neck, pulsating with the artery, will not prove to be aneurism in one example out of perhaps a dozen. It may be an enlarged gland or series of glands, or an encysted tumor, or enlargement of one lobe of the thyroid body, or the material of an abscess, or malignant growth, or any disease but an aneurism. If glandular, other glands may be felt about the neck also enlarged; the tumor will be rounded, or, at least, circumscribed and firm. The mass is *jerked* by the action of the artery underneath it, not *expanded* by the increased quantity of blood forced into the cavity. The person may be strumous in character. The glands may have been more or less enlarged for a period far beyond that which develops aneurism.

The late Mr. Burns, in his "Anatomy of the Head and Neck," recommends that the tumor be raised by the fingers from off the artery, when the pulsation will cease. No doubt it will; but it is impossible to grasp any tumor of the neck beneath either the sterno-mastoid muscle or the cervical fascia. If an encysted tumor, it will also have existed for a far longer period; it will be circumscribed and soft. If an abscess, the period of its existence will prove, on inquiry, to be shorter in duration. It will be painful more or less. It will not vary in form by reason of the pulsation of the carotid underneath it; and in this, as in the former case, we have the important negative evidence of the absence of the influence of the real disease on the branches of the carotid beyond it. The enlargement of one or other lobe of the thyroid body is a frequent occurrence, and is occasionally mistaken for aneurism. This enlargement may exist over the carotid artery. Its nature is softer and more elastic than that of ordinary tumors in this situation; it has a more marked pulsation than other tumors, consequent on its large supply of blood; and I have seen more than one example of this disease that had many of the external attributes of true carotid

aneurism. On examination, however, the opposite lobe is found, though in a less degree, the seat of the same enlargement. The isthmus also will be found in some measure to participate in the altered structure. It will generally be observed to exist in the young female. Its growth has been slow and uninterrupted; it is often more irksome than usual during the menstrual periods. It will also rise and fall with the larynx in the act of swallowing, proving its intimate relationship to the air-tube. Negatively, and often the most valuable evidence, it wants the peculiar expansion of aneurism, and the influence of a true aneurismal tumor on the branches of the artery above it. Malignant diseases are so various in their form and origin that it is not surprising if we occasionally meet with examples of such disease in the neighborhood of the carotid artery that may be mistaken for aneurism of that vessel. A medical friend of mine, and an excellent surgeon, residing in the north of England, in the year 1848, wrote to me to the following effect:—"I am just sent for to ——, many miles distant, to examine and report on a case of carotid aneurism. I am aware how frequent is the appearance of this disease, and how rare is the reality; but if it prove to be aneurism, I shall send the man up to you at St. Bartholomew's Hospital." On the day but one following, the man arrived. It was a malignant growth, and not aneurismal disease, and the man died.

Carotid aneurism is ill-defined in form, firm in texture; it is not formed *upon* the artery, but enters into its structure; its pulsation is not conveyed to it, but is of it; it forms a part of the vessel itself; it has existed, perhaps, two or three months, and gradually enlarges, at a uniform rate of growth; increasing, however, as it advances; the pulsation in the branches beyond it, all partake of its influence, their calibre is reduced below that of the opposite side. The sense of local annoyance is permanent, not occasional, as in the hysteria attending thyroid enlargement. It is usually attended with pain and throbbing in the affected side of the head, hoarseness of voice, cough, and difficulty of breathing, caused by pressure of the tumor on the larynx or trachea. The local symptoms are increased when in the horizontal position. As has been remarked elsewhere, the real disease is rarely mistaken, diseases simulating it, frequently.

This operation was first performed by Mr. Abernethy in this country, and has been repeated successfully by many eminent sur-

geons in England, and on the Continent. The carotid artery may be required to be tied, either in the upper or the lower part of its course; i. e. either above or below the omo-hyoideus muscle. If the aneurism be low in the neck, so near the chest as to render it probable that great difficulty will be experienced in passing a ligature around the artery, between its origin and the sac, which would be indicated by the presence of the tumor underneath the sternal origin of the mastoid muscle, Brasdor's operation, revived by Mr. Wardrop, should be resorted to, viz., that of tying the vessel on the distal side of the aneurism. For aneurisms of the carotid the lower part of the vessel is usually selected, the upper being tied for aneurism of its branches, hemorrhage, or vascular tumors. Sabatier recommends, for the purpose of tying the carotid in the lower part of the neck, an incision corresponding with the interval between the sternal and clavicular origins of the sterno-mastoid muscle; but this incision is objectionable. The head of the patient being placed nearly horizontally, but a little raised, and the face turned slightly round to the opposite side, an incision of about two inches and a half in length is to be carefully made through the skin, commencing at that distance above the sternum, upon the anterior edge of the mastoid muscle, and continued downwards, so as to pass on to the tendinous origin of that muscle from the sternum, about a quarter of an inch. This incision will divide the integuments and some fascia, and some fibres of the platysma above. The anterior edge of the mastoid is then to be exposed, the muscle hooked up, and drawn outwards by a retractor; and for this purpose the patient's head should be brought round, and considerably raised on a pillow.

The sterno-hyoid and thyroid muscles, if the artery be required to be tied very low, should be drawn inwards, when separated with a blunt knife, and with them the filaments of the descendens noni nerve. The omo-hyoid may be exposed, when crossing the artery at the upper angle of the wound, or not.

The sheath of the vessels should be divided on a director, to the extent of an inch, and the large veins, from the thyroid body drawn asunder; the finger being applied to the bottom of the wound, will readily detect the pulsations of the artery. Great care should be taken to avoid these veins, which often become largely distended with every act of expiration, and present great difficulties to the operator.

Fig. 35.

A. Carotid artery.—B. Jugular vein.—C. Descendens noni.—D. Sterno-mastoid.

If the operation be performed on the right side of the neck, within an inch or more of the sternum, the internal jugular vein will be partially, if at all exposed; if on the left, the jugular vein will be found lying upon, and almost covering the artery on its outer side, and should be very carefully drawn outwards. The carotid should now be partly insulated by dissecting around it, and the needle passed underneath it from without inwards, great care being taken that nothing but the artery be included; for it should always be kept in mind that on the left side, the thoracic duct, in addition to the inferior thyroid artery, and many nervous branches common to the two sides, lie nearly in contact with it.

For the purpose of tying the carotid artery in the upper part of its course, an incision two inches, or two and a half, should be made along the anterior margin of the mastoid muscle, beginning on a level with the upper border of the thyroid cartilage. This incision will divide the skin, platysma, and general fascia of the neck.

The mastoid muscle being exposed, the head should be raised as in the former operation; and the muscle thus relaxed should be drawn outwards by a blunt and broad hook or retractor.

When the sheath is exposed to view, the descendens noni nerve will be seen descending along it; this nerve should now be drawn outwards, and the superior thyroideal veins be carefully hooked, either upwards or downwards, according to the convenience of the operator. The finger should be repeatedly applied to the artery, in order to ensure its being exposed towards the middle of its front

surface. When the sheath is divided, and the artery cleared of its cellular structure, both in front and at each side, for a few lines in length, opposite the part at which the ligature is to be applied, the needle may be passed around it from without inward, or, if more convenient, in the opposite direction; great care being taken not to include the pneumogastric nerve, by keeping the point of the needle as close as possible to the posterior surface of the artery. It is very important that as little violence as possible be done to the parts involved in this disease. The formation of abscess has led to a fatal result, in many cases of great early promise. The thread being tied, the divided parts should be replaced as much as possible in their natural relations.

OPERATION FOR TYING THE SUPERIOR THYROID ARTERY.

This artery is occasionally tied in the treatment of bronchocele. The degree of difficulty of the undertaking depends greatly on the form of the enlargement of the thyroid body. The thyroid artery may be readily exposed in the neck of an ordinary person, and not less so, occasionally, when the thyroid body is enlarged. If in such cases the enlargement involve the entire body of the lateral lobe, then the vessel which is distributed to the anterior surface of the organ is pressed forwards underneath the skin, and its pulsations become apparent to the eye. In other examples, however, the growth of the thyroid body is lobulated and irregular, and composed of watery cysts; and then the lateral lobe overlaps the artery supplying it, and presses it inwards from the skin towards its under surface. Under these circumstances the attempt to tie the superior thyroid artery would be attended with difficulty, and some danger. In two cases in which this operation was performed by Mr. Earle, in St. Bartholomew's Hospital, the artery was large and prominent, and the operation was easy. Sir W. Blizard tied the superior thyroid in a case of bronchocele with some success, as regards its influence on the disease, although the patient died; her death being referable to remote causes. In Mr. Earle's cases, the operation also tended to check very considerably the growth of the tumors.

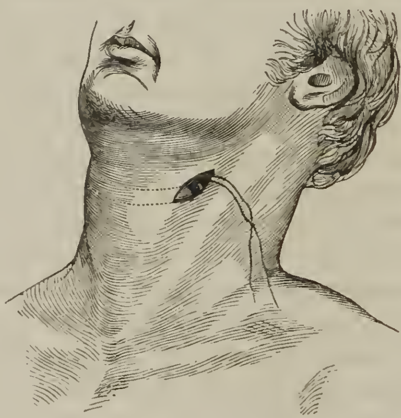
The patient's head should be placed nearly horizontally, and the neck elongated; and the course of the artery being marked out by a line drawn downwards and inwards, from a level of half an inch above and behind the upper border of the thyroid cartilage, an inci-

sion of from an inch to fifteen lines in length should be made across it, opposite the lower edge of the cartilage. The skin and platysma being divided, the cervical fascia should be opened, the mastoid muscle drawn outwards with a blunt hook, and the remaining parts separated with a silver knife; at the bottom of this wound the artery will be found. If the growth of the thyroid lobe be such as to press the artery forward, it will be rendered so superficial as to render any further detail unnecessary.

OPERATION FOR TYING THE LINGUAL ARTERY.

The lingual artery is occasionally tied in cases of hemorrhage from the tongue, the inosculating branches between the two vessels being inconsiderable. When the lingual artery arises low down from the external carotid, it curves upwards and forwards around and nearly in contact with the tubercle, forming the extremity of the great cornu of the os hyoides. When it arises half an inch higher, this curve is not made, but under all circumstances it lies on the constrictor medius of the pharynx and *crosses the superior laryngeal nerve.*

Fig. 36.



The head of the patient being placed horizontally, and the neck lengthened by raising the chin, an incision of about twelve lines in length should be made immediately behind the corner of this bone, the outline of which should be distinctly ascertained before proceeding to the operation: the incision should be directed downwards and

forwards. The skin and platysma being divided, the fascia is exposed, which should be also divided to the length of the external wound. The facial vein, often of considerable size, may be brought into view at the upper part of the wound, in its course downwards to the internal jugular, and should be drawn outwards. The remaining parts should be torn, rather than cut asunder, passing transversely inwards, nearly parallel to the upper edge of the cornu of the os hyoides, when the artery will be exposed. In passing the needle behind it, care must be taken to avoid the superior laryngeal nerve, which descends nearly at right angles behind the artery.

OPERATIONS FOR TYING THE FACIAL ARTERY.

The facial artery may be tied in the neck, or on the lower jaw. The origin of this artery is usually at a distance of about a quarter of an inch above that of the lingual. Taking the tubercle of the os hyoides as the guide, the external incision should be commenced in the skin, about half an inch higher than in the preceding operation. The artery will thus be exposed before it passes underneath the digastricus, and stylo-hyoid muscles, or dips into the substance of the submaxillary gland. The facial artery is here crossed by the hypoglossal nerve. On the inferior maxillary bone the facial artery

Fig. 37.

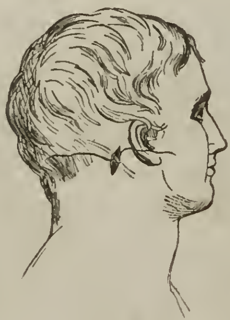
may be readily exposed by an oblique incision upon the bone, immediately in front of the anterior border of the masseter muscle,

and this margin may be as readily detected, by desiring the patient to close his jaws, by compression of the molar teeth against each other. The oblique incision in this situation not only insures the readily finding the artery, but it divides fewer filaments of the facial nerve. The facial vein lies on its outer side, between the artery and the masseter muscle.

ON THE OPERATION FOR TYING THE OCCIPITAL ARTERY.

Leaving the trunk of the external carotid, the occipital artery passes backwards, through a kind of loop of the hypoglossal nerve, and becoming nearly horizontal, it lies in a groove in a temporal bone, underneath the mastoid process, and beneath the muscles attached to it, and to the oblique ridge extending backwards on the occipital bone, viz., the sterno-mastoid, the splenius capitis, and occasionally only underneath the trachelo-mastoid muscle, at the back of which it emerges, lying on the occipital bone. It is here placed at a distance of about an inch and a half behind the external ear, covered only by the dense tissue of the scalp, and is accompanied by one or more veins. The distance, however, of the artery behind the external ear will depend on the breadth of the insertion

Fig. 38.



of the mastoid muscles, and this extent varies in different persons. It would be well to vary the distance from an inch and a quarter to an inch and a half, according to the general muscularity of the individual. The occipital artery may be exposed by an incision of about an inch in length, carried obliquely downwards and backwards across its course.

ON THE OPERATION FOR TYING THE TEMPORAL ARTERY.

The course of the temporal artery can be traced by the finger passing upwards immediately in front of the cartilaginous structure of the external ear, and over the root of the zygoma. In this situation, the artery should be clearly exposed before the ligature be passed around it, lest the auriculo-temporal nerve or a filament of the portio dura be included within it; an incision of about nine lines in length should be made obliquely across the artery in either direction. The instruments employed should be fine, and the operation delicately performed, for the reason above stated. The artery and the artery alone should be included in the ligature.

Fig. 39.

A case of some interest involving this vessel occurred to me in 1847, in the person of a young lady. A small swelling formed upon the temporal artery, which appeared to me to exhibit the characters of aneurism. She was not conscious of having sustained any injury to the vessel by blow or otherwise. The pulsation was manifest to herself, and as the tumor increased in size, its pressure on the meatus auditorius became a source of great discomfort, particularly when she attempted to lay that side of her head on the pillow. Sir B. Brodie saw her, but doubted the aneurismal character of the disease. Some months elapsed, and she saw Mr. Liston, in conjunction with Sir B. Brodie and myself. It was then deemed aneurismal, and I tied the artery below the tumor. For some days the tumor, which had reached the size of a large bullet, diminished in size, and after remaining for some weeks stationary, it again began to increase. I had no doubt of its aneurismal nature,

even at that time, but I considered it an erectile tumor communicating with the trunk of the vessel, because pressure on the artery below invariably reduced it greatly in size. Mr. Aston Key then saw it, and immediately pronounced it aneurismal. Its peculiar nature precluding any further operation upon it, I had a fine spring compress made by Ferguson, with a ball-and-socket joint, which passed over the head, and made permanent pressure on the tumor. The instrument was entirely concealed by her hair. My patient wore this instrument for fifteen months, at the expiration of which, the tumor had become solid, and all pulsation had permanently ceased.

ON THE OPERATION FOR TYING THE ABDOMINAL AORTA.

Descending from between the crura of the diaphragm, the aorta lies a little to the left side of the centre of the vertebral column, having the vena cava inferior on its right, and nearly in contact with it. Its division into the two common iliacs takes place on the body of the fourth lumbar vertebræ, just below the level of the umbilicus. The inferior mesenteric is given off from the aortic trunk, on the left side of the middle of the vessel, about two inches above its bifurcation. Two lumbar arteries arise from it, within half an inch of its bifurcation. The left lumbar veins pass behind it. The trunks of the two sympathetic nerves lie on the bodies of the vertebræ, a few lines only from the surface of the vessel. The abdominal cavity is lined by the peritoneum, which is placed posteriorly in close apposition with a loose fascia covering the aorta. In order to expose the vessel from the front of the abdomen, two layers of this membrane must necessarily be divided, and the intestines pushed aside. The depth from the abdominal parietes, through which the first incision is made to the aorta, across a cavity already occupied by intestine, must in some subjects be very great.

This operation was first performed by Sir Astley Cooper, in the year 1817, for an aneurism of the external iliac artery that had sloughed. He made an incision, three inches in length, along the line of the linea alba, curving the line to avoid the umbilicus: having opened the cavity of the abdomen, he pushed aside the intestines, tore through the peritoneum covering the artery, with his finger-nail, and passed an armed needle around it, at a distance of

three quarters of an inch above the bifurcation. The patient survived the operation two days.

The aorta was also tied by Mr. James, of Exeter, in the year 1829, for aneurism of the external iliac artery, for which, a month prior, he had performed the operation of Brasdor, by tying that vessel on the distal side of the aneurism. The operation of Mr. James corresponded with that of Sir A. Cooper. The patient survived some hours only.

The question as to the feasibility of tying the aorta on the living subject, without the immediate destruction of life, may be said to have obtained conclusive evidence in its favor by these two operations, and more especially by that of Sir A. Cooper. It is a matter of history, that nearly all the early operations on large vessels have proved fatal, and that complete success has finally crowned the repetition of the attempt. The success of Sir A. Cooper's operation on the aorta was sufficient to justify its repetition in a case of equal emergency; and it would be the equally justifiable resort of the surgeon on such conditions, even were it certain that four out of five operations must prove necessarily fatal, for death is certain without it. It may be doubted, however, whether the kind of operation practised in the above cases was that most likely to insure a favorable result. The exposure of the cavity of the abdomen, the violence done to the healthy peritoneum, and the handling and concussion of the intestines, are very probable elements of future evil. Nature is very jealous of any degree of exposition of the cavities of the body; and when we add to the evil of this violence, that also done to the largest vessel of the arterial system, we shall not be surprised at the result. One half of this difficulty may be averted by another operation, viz., that of tying the aorta behind the peritoneal cavity, by an incision which would admit of the peritoneum being raised with the mass of intestines, without being opened. Should opportunity, unfortunately for the individual, occur, we can see no reasonable ground why success should not become at least its occasional, if not its frequent attendant, such is the admirable machinery of the arterial system. The nature of this operation will be described in that of the operation for tying the common iliac artery, and to which the reader is referred.

ON THE OPERATION FOR TYING THE COMMON ILIAC ARTERY.

At the lower border of the fourth lumbar vertebra, the aorta divides into the two common iliac arteries, which, diverging from each other and from the mesial line, pursue a course of about two inches, lying on the inner side of each psoas magnus, where they subdivide into their secondary branches. The course of these two vessels in the subject is indicated by a line drawn from the centre of the abdomen, half an inch below the umbilicus, to a point in Poupart's ligament, midway between the anterior superior spine of the ilium and the symphysis pubis. This line follows the course of both the common and external iliac arteries, with sufficient precision for all useful purposes. A great variety occasionally prevails in the length of the common iliac artery, and consequently on that of the two consecutive branches into which it divides. This vessel, of an average length of about two inches, is often found to exceed that length by one or even two inches, under which circumstances the external and internal iliac are reduced in the same degree in their average dimensions. Occasionally the division into these secondary branches takes place at the termination of one inch or more of its course. These peculiarities should be kept in mind by the surgeon while operating on either of these three vessels. The right common iliac artery crosses the right common iliac vein, the left artery having its corresponding vein on its inner or mesial side. Each common iliac artery is crossed obliquely by the ureter of its own side; but the connection of the ureter to the peritoneum is somewhat stronger than that to the artery, for in raising this membrane the ureter usually follows it. The peritoneum is applied loosely upon the iliac arteries, and is raised from them without difficulty. The distance of the arteries from the front of the abdomen will vary of course, according to the degree of obesity of the person under inquiry, and to the condition of repletion of the intestines.

In a case of aneurism of the external iliac, which is obviously seated high up in the artery, conveying a considerable pulsation to the parts around, and forming a tumor in the lateral part of the abdomen, some inches in extent, above Poupart's ligament, perceptible through the abdominal walls, and more especially if the tumor be so placed as to raise the question of its probable seat in the internal iliac, it would become necessary to apply a ligature

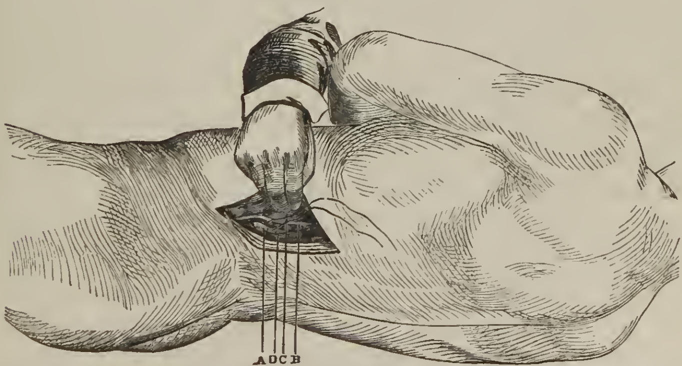
around the common iliac, and this operation, formerly deemed impracticablc, with any probability of success, has been performed on several occasions.

The common iliac artery was first tied in New York, by Dr. Mott, for aneurism of the external iliac, in the year 1827, and in 1828, by Sir P. Crampton, in Dublin, for the cure of the same disease. Dr. Mott's case recovered.

The operation performed by Dr. Mott was founded on that adopted by Mr. Abernethy, for tying the external iliac artery, and consisted of an incision made through the parietes of the abdomen over the vessel. That of Sir Philip Crampton, although in that individual casc unsuccessful, was a great improvement on its predecessor. A repetition of this operation was performed in St. Bartholomew's Hospital, in the year 1846, by Mr. Stanley, for the cure of a disease of the left ilium, and as it appeared to me that the object was attained in his hands with remarkable facility, I cannot do better than record my recollection of its details.

The patient, a middle-aged man, was placed on the operating table, with his body inclined over to the right or sound side, the shoulders and trunk were bent a little forwards, for the purpose of rendering the lumbar integument tense. The line of the last false rib being ascertained, an incision was made from its cartilage or nearly its point, in a line downwards, and somewhat forwards, to the crista ilii. This incision was about three to four inches in length. The

Fig. 40.



A. Artery.—B. Ureter.—C. Peritoneum.—D. Psoas magnus muscle.

division of the integument was followed by that of the external obliquc, internal oblique, and transversalis muscles, singly and

successively. The external incision was then elongated along the line of the crista ilii, to the extent of about three inches more, and the division of the three muscles from the bone completed; comparatively little blood escaped. Reverting to the situation of the first incision, Mr. Stanley then divided the fascia which lines the inner border of the muscles in this situation, and extended the division of the fascia to the entire limit of the external wound. He then raised the mass of intestine enveloped in the peritoneum, and pushed it inwards, bringing into view the psoas magnus, left ureter, and, finally, the common iliac artery, around which he passed a ligature, without any apparent difficulty.

I consider the advantages of this over the anterior operation to be very striking; first, inasmuch as the abdominal parietes must be divided, it is a less objectionable region in which to divide them, because less sensitive, and less liable to consequent inflammation. Secondly, the requisite separation of the peritoneum from its relations to the abdominal walls is less extensive, and consequently we have less liability to suppurative action. In the anterior operation the detachment of the membrane from the walls of the abdomen is much more extensive. Thirdly, in the posterior operation the artery is brought fairly into view, and the act of passing the needle around it is made visible to observers around. The external incision in the case of Dr. Mott was eight inches in length! and must have extended from Poupart's ligament nearly to the umbilicus. Fourthly, by tying the common iliac artery by means of the posterior operation, the line of the vessel is sufficiently exposed, to enable the operator to select his point of contact for the ligature, to carry it either higher or lower, or even, if necessary, to separate the peritoneum from the aorta itself, and to pass a ligature around that vessel, at a sufficient distance above its bifurcation: and, fifthly, should the patient recover, the formation of ventral hernia, consequent on the imperfect union of the muscular parietes, is less likely to occur than in the anterior operation. It is no evidence unfavorable to this plan of operation, that both the case of Sir P. Crampton and Mr. Stanley failed, any more than it is favorable evidence to the anterior operation that the case of Dr. Mott recovered. It is only by frequent repetition that the respective merits of the two operations can be practically ascertained, and I have no hesitation in expressing my preference for the English operation.

OPERATION FOR TYING THE INTERNAL ILIAC ARTERY.

The internal iliac artery descends from the point of bifurcation of the external iliac along the walls of the pelvis. It diverges from the external iliac, at an angle of about 25°, and proceeds forwards to the extent of about an inch before it yields any branches, of which the first is the ilio-lumbar. The right artery lies in front of the corresponding vein, but the left crosses in front of the left *external* iliac vein, having on the right side the left internal vein immediately behind it. But many, yet large though lesser veins congregate around and empty themselves into it in this situation. The ureter on each side is placed internal, and a little posterior to it. Both arteries and veins are invested by a layer of the pelvic fascia, upon which is placed the peritoneum. If a line be drawn from the mesial line of the abdomen, half an inch below the umbilicus to Poupart's ligament, midway between the anterior superior spine of the ilium, and the symphysis pubis, and the two upper inches of such a line be allowed for the common iliac artery, a second line, drawn downwards from this point, at an angle of about 25° with the first, nearly parallel to its fellow of the opposite side, will indicate, with tolerable exactness, the course and direction of the internal iliac artery, with respect to the anterior wall of the abdomen.

The internal iliac is the subject of operation in cases of aneurism of the gluteal or other of its branches. Its situation and relations in the pelvis would hopelessly preclude its certain diagnosis if diseased; for the only accessible direction by which its symptoms could be manifested, would be that directly forwards, in which case the disease would be in all probability referred to the external iliac. It has usually been tied for aneurism of the gluteal artery, and it would be equally compulsory in a similar affection of the ischiatic or pudendal, or, indeed, in any one of the primary branches, could the existence of such disease be ascertained with certainty.

This operation was first performed in the year 1812, by Mr. Stevens, of Vera Cruz, on a slave woman, for gluteal aneurism:* the woman recovered; and a second time by Mr. Atkinson, of York, whose patient died on the nineteenth day.

The process of exposure of the artery, adopted by Mr. Stevens, consisted in an incision made through the anterior abdominal pa-

* Medico-Chir. Trans. Vol. V.

rietes. This incision was five inches in length, and was situated "at the lower and lateral part of the abdomen, parallel to, and about half an inch on the outer side of the epigastric artery." This process is yet practised in the operation in question, and is probably the most eligible that can be adopted.

The posterior operation labors under considerable disadvantages, in reference to the internal iliac, which are not referable to the common iliac. By the posterior incision the internal iliac is concealed behind the bone, the cavity of the pelvis is not exposed to view, the internal lies behind the external iliac, and being surrounded by numerous and large veins, any wound of which would probably prove fatal, such an operation is, I conceive, objectionable. Although I believe the finger could be placed in contact with the artery more readily in the posterior than in the anterior operation, yet the eye could not so readily reach it; and this circumstance is fatal to a safe proceeding, and the difficulty of the posterior operation would be materially increased, if, during its performance, it appeared that the common iliac were of unusual length. In that case there would remain no other alternative but that of tying that vessel. We must, therefore, resort to the anterior operation, and for this purpose an incision should be made over the line of the artery, the direction of which will be ascertained with care and precision. The external iliac artery passes under Poupart's ligament, midway between the anterior superior spine of the ilium, and the symphysis pubis; from this point, the course of the trunk is indicated, as above stated, by a line drawn upwards and inwards to meet its fellow half an inch below the umbilicus. The upper two inches of this line will correspond with the common iliac, and from this point the two iliac arteries diverge from each other, the internal descending forwards at an angle of about 25° or 30° with the other branch.

This point of subdivision between the two iliac arteries is about the distance of from four to five inches above Poupart's ligament, and about four inches from the crista ilii, opposite which it lies. If we take half an inch internal to this line for the internal iliac, we shall hit the exact line of the vessel. It is unnecessary to make this incision of immoderate dimensions. Probably from four to five inches will suffice for all the manipulation required, and every half inch of incision saved to the patient not only promises a more favorable immediate result, but renders the occurrence of ventral hernia less probable. The incision should be commenced at a point about

one inch above Poupart's ligament, and continued upwards and inwards, over the line of the *external* iliac artery, or along this line from above downwards. Such an incision will permit of the integuments and muscles being sufficiently drawn inwards to enable the operator to expose the artery to his ready view. Some additional care is requisite in dividing the fibres of the transversalis muscle, lest the transversalis fascia, which lines its under surface, be wounded unintentionally and the peritoneum be injured.

When the transversalis muscle is fully divided to the extent of the division in the outer skin, the fascia transversalis should be equally divided, by means of a director passed underneath it. The hand, then passed into the wound, should carefully separate the peritoneum from the iliac fossa with the mass of intestines. This is now the only obstacle to the exposure of the artery; but great gentleness and a light hand are requisite for this purpose. The iliacus internus and the psoas magnus will be thus brought successively into view; and on the middle of the latter muscle will be felt the pulsations of the external iliac; and still more internally, and within the cavity of the pelvis, i. e., about one inch lower, will be felt those of the internal iliac artery. The vessel should be exposed to the sight and examined, more especially in the act of passing the ligature, lest injury be done to the veins which ramify about it. The needle will be most readily introduced on the outer side of the vessel; the cellular connections of which should be carefully separated by a blunt, or silver knife, before attempting to pass the needle around it.

OPERATION FOR TYING THE EXTERNAL ILIAC ARTERY.

The external iliac artery, commencing at the bifurcation of the common iliac trunk, is situated at its origin from that vessel, on the inner side of the psoas magnus muscle; and, at its termination, underneath Poupart's ligament, it lies on the anterior surface of the muscle. The artery generally presents a curve, the convexity of which is downwards, towards the pelvis, which is marked more positively in the female than in the male subject. Sometimes the curve is very considerable. In this course of from four to five inches, it arches forwards and outwards, to reach the front surface of the psoas, which is external to it, lying, however, somewhat nearer to its inner than to its outer side.

Here, again, I must remind the reader of the uncertain length of

the external iliac artery. It is obvious, from this description and from the recollection that the curve of the crista ilii bends round towards it, in its descent, to reach the anterior superior spine of the ilium, that, as the artery reaches Poupart's ligament, it gradually approaches the front of the abdomen, and also approaches the side of the body.

The right external iliac *vein* passes underneath the corresponding artery (the vena cava inferior being on the right side of the aorta), and underneath Poupart's ligament, it lies to its left, or inner side; while, on the left side of the body, the external iliac *vein* having crossed underneath the internal iliac *artery*, descends along the right or inner side of its corresponding artery. In other words, the vein lies internally to the artery on both sides. The external iliac artery is accompanied by a fine branch of the lumbar plexus, the genito-crural, which lies either on its anterior or on its inner surface; the plexus itself being separated from it by the psoas muscle, in the substance of which it is imbedded. Although these vessels lie upon the fascia iliaca, they receive an investment of that fascia which covers them in the whole of their course. The peritoneum, which invests the abdominal contents, is reflected laterally from the anterior walls of the cavity, into the iliac fossa; and again, backwards, over the vessels, to which it is attached by a very loose cellular tissue. Just before its passage underneath Poupart's ligament, the artery is crossed by the vas deferens. The external iliac furnishes two branches only, the circumflexa ilii, and the epigastric; the origins of which vary from three to eight lines above Poupart's ligament. It is also surrounded, in common with the vein, with a numerous and irregular chain of absorbents. In a case in which Mr. James tied the external iliac artery, a double vessel was found on examination after death. I have never met with a parallel example.

The external iliac artery was first tied by Mr. Abernethy, in the year 1796. The patient had undergone Hunter's operation for a popliteal aneurism. A second aneurism formed in the opposite femoral, for which Mr. Abernethy tied that artery below Poupart's ligament. Hemorrhage occurred on the fifteenth day, for which he tied the external iliac, within the cavity of the abdomen. The patient died. Mr. Freer, of Birmingham, repeated this operation, in 1806, with success. In the same year, Mr. Abernethy performed his third operation on this artery, and also with success. It has

been since undertaken by most of the leading surgeons of England, and by many in France, with such results as to justify the resort to it in all cases in which the arterial trunk of the lower extremity is diseased so close to Poupart's ligament as to preclude the possibility of passing a ligature around the artery below it.

The line of artery should be clearly defined according to the rules above indicated, and the patient laid quite horizontally on the table. The full extent of the tumor should be ascertained by careful examination through the parietes of the abdomen, and whether it extend very high upon the artery or not, this inquiry will furnish important results to the surgeon.

If the diseased condition of the artery be manifested by large pulsation, to the extent of three or four inches above Poupart's ligament, the only safe alternative will consist in tying the common iliac trunk. It is no argument against this necessity that the external iliac artery is rarely if ever diseased to such an extent, because we have no reason to suppose the upper or middle part of this vessel to be free from the liability to aneurismal disease, of which possibly any day may furnish an example. The proceeding adopted by the operator will entirely depend on the extent of the tumor above Poupart's ligament. Of course some degree of doubt may prevail in a fat subject, whose prominent abdomen and distended intestine may preclude the possibility of a very satisfactory inquiry; but, as a general rule, the pulsations of the tumor will be sufficiently distinct to permit a sound conclusion to be drawn on this subject. If the tumor extend to a distance of two inches or more above Poupart's ligament, it is obvious that that form of operation should be selected which will efficiently expose the artery above it. If the disease be confined to the femoral, at, or immediately below Poupart's ligament, the exposure of the vessel even at the lowest part of its course, i. e., immediately above the ligament, will suffice. It is one important element in the successful result of an operation on the external iliac artery, that the contents of the abdomen be as little disturbed as possible; and therefore, in the abstract, that operation should be always preferred which will least conduce to this evil. The operation of Mr. Abernethy, in 1796, laid the artery bare in the direction of its course, to the extent of about three inches, by a longitudinal incision. That of Mr. Freer, since modified by Sir A. Cooper, exposed the vessel by an incision more approaching to a transverse direction. The latter is the simpler operation, and less

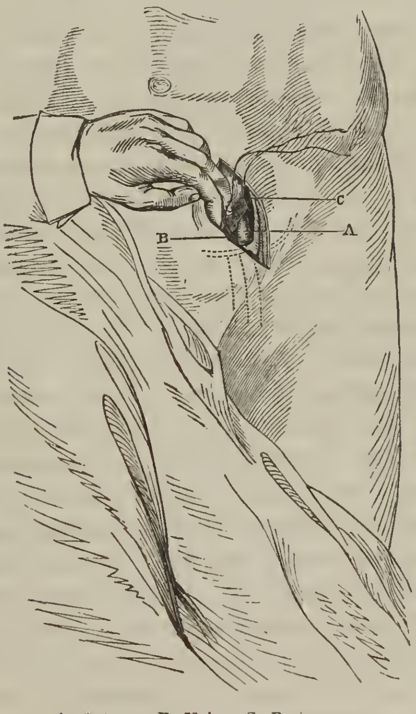
liable to subsequent evil. But the first consideration is due to the necessity of the disease, and according to the evidence of the aneurism, involving the artery high up in its course, say to one inch or more above Poupart's ligament, is the operation of Mr. Abernethy, or that of Mr. Freer modified by Sir Astley Cooper, to be preferred. The merit of Mr. Abernethy's operation consists in the extent of the exposure of the artery to a distance above Poupart's ligament, and by which the occasional uncertainty of diagnosis is most effectually met. That of Mr. Freer has the advantage of greater simplicity, and in cases of disease confined to the femoral artery, is certainly more eligible, inasmuch as the artery is exposed in a nearly transverse direction, close to Poupart's ligament, with far less displacement of the peritoneum than is required in the former case. The objections to either one of these plans for operation in any given case are founded on the merits of the other: that in Mr. Abernethy's longitudinal incision is attended by the necessary evil of extensive separation of the peritoneum from the walls of the abdomen; the greater difficulty of bringing the artery fully into view; the almost certainty of including in the ligature the genito-crural nerve; and the greater liability to the occurrence of ventral hernia, on the healing of the external wound; that of Sir A. Cooper being totally inapplicable to disease of the artery that is not confined to the vessel below Poupart's ligament, or immediately underneath it. If, on the completion of the transverse operation, disease be found to have extended higher along the artery than a careful inquiry had previously ascertained, little advantage would accrue from its performance, and the longitudinal incision, recommended by Mr. Abernethy, must be resorted to, with a view to expose the artery beyond it. If, on the exposure of the vessel, it appear that the common iliac is of unusual length, and the disease have involved the coats of the vessel close to the bifurcation, it will be necessary to apply the ligature at once upon the common iliac artery.

This operation consists in an incision through the abdominal parietes to the extent of from three to four inches. The patient should be laid quite horizontally on a table, for the purpose of keeping the muscle in a moderately tense condition, the head being raised on a pillow. The line of the vessel should, as in the case of the internal iliac, be marked out with ink. The integuments being divided to the above extent, commencing at the distance of four inches above Poupart's ligament, the stratum of fat and cellular

tissue, which bears the name of superficial fascia, should be divided down to the level of the aponeurosis of the external oblique muscle. If in this division of the fascia, the superficial epigastric artery bleed freely, it should be tied, for much of the success of the after stages of the operation depends on the wound being kept clear of blood. The aponeurotic tendon of the external oblique should be cut asunder in the same direction, continuing the incision downwards, to within one inch of Poupart's ligament.

To the same extent is the division of the internal oblique and transversalis muscles to be made; care being taken to leave untouched the spermatic cord, emerging below the lower border of these two muscles. The muscles should be fully divided *nearly* to the extent of the outer wound. The fascia transversalis is then

Fig. 41.



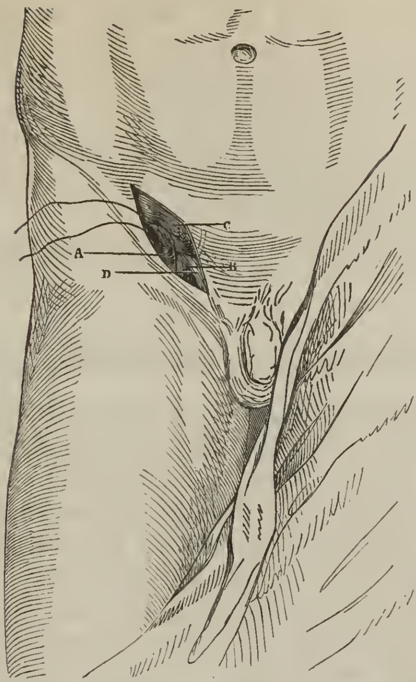
A. Artery.—B. Vein.—C. Peritoneum.

brought into view, and should be carefully divided on a director, to the length of the division in the muscles. The peritoneum is now exposed. By easy manipulation, with a clean hand, and with the

nails reduced, if necessary, to an ordinary length, and not projecting beyond the extremity of the fingers, the peritoneum is to be drawn inwards from the iliac fossa, with the left hand for the artery of the left side, and *vice versâ*, towards the mesial line of the abdomen, with the intestines enclosed within it. The psoas magnus is then brought into view, and upon its inner side lies the external iliac artery, advancing forwards on to its anterior surface. The extent of the disease is now perceptible by the exposure of the artery, for three to four inches above Poupart's ligament. With a silver or other blunt knife, the fascial sheath investing the artery should be divided at the part of the vessel around which it is intended to apply the ligature, the coats of the artery fully exposed to the eye, and the genito-crural, a very small nerve, avoided if in contact with it. The peritoneal bag may be held off the vessel on the left side, by the two fingers of the operator; if on the right, by the application of a sufficiently broad retractor. One end of the ligature should be brought out at the lowest extremity of the wound, which may be united, as regards the muscles, by apposition alone; the trunk of the patient being bent forward in the semi-recumbent position, and sutures applied through the wound in the integuments.

The operation of Sir A. Cooper consists in a semilunar incision, made in the direction of the fibres of the external oblique muscle. This incision is commenced about an inch from the anterior superior spine of the ilium, and carried downwards across the artery, nearly as far as the external abdominal ring. The convexity of this arch looks downwards towards Poupart's ligament. Mr. Norman's external incision varies from the above, in being formed by a straight line parallel to that ligament. The aponeurosis of the external oblique is now divided by a second incision, corresponding with the first, which exposes the spermatic cord, descending from the lower border of the internal oblique, to enter the inguinal canal. The cord is raised with the cremaster muscle and fascia investing it, and drawn upwards with a blunt hook. All that now remains is to divide the fascia transversalis, where it forms the posterior boundary of the inguinal canal, which may be effected by the introduction of a director along the line of the canal. Underneath this fascia the artery will be readily exposed, if care has been taken prior to the operation to ascertain its exact course. The vein lies to its inner side. The sheath of the artery should be detached from it, and the armed needle passed underneath it from within outwards, or *vice versâ*.

Fig. 42.



A. Artery.—B. Vein.—C. Peritoneum.—D. Spermatic cord.

It would be desirable, if possible, without unnecessarily detaching the sheath of the vessel, to ascertain the relations of the epigastric and circumflexa ilii arteries to the part of the iliac trunk around which the ligature is about to be applied. The operator will call to mind the well-known case of Mr. Travers, in which the iliac artery was tied between the origins of these two vessels, and which operation proved fatal, by the current of blood being maintained in the artery up to the ligature, and passing into the epigastric, which was given off above it. The inner structures should be replaced as much as possible in their natural position, and four or five fine sutures employed to unite the fibres of the aponeurosis of the external oblique muscle, and two or three larger sutures applied to the lips of the external wound.

In both of the above operations, slight pressure should be made, by means of wadding, over the divided parts.

If it be intended to tie the artery *immediately* above Poupart's

ligament, I consider the straight incision of Mr. Norman preferable to the semilunar incision of Sir A. Cooper. If any doubt remain as to the extent of the disease, the semilunar incision is more desirable, inasmuch as it permits of a somewhat more extensive exposure of the vessel above the ligament. If on its exposure, however, disease, contrary to expectation, be found to exist, the longitudinal incision of Mr. Abernethy should be made upwards, through the inner muscles, in the direction of the artery.

For wounds, &c. of the epigastric and obturator arteries, *see* HERNIÆ.

OPERATION FOR TYING THE FEMORAL ARTERY.

The thigh is invested with a layer of fat and fibrous tissue, of about half an inch in thickness, called the fascia superficialis. This fascia, as it is termed, separates the skin from the fascia lata, while it gives rotundity to the thigh, and forms a bed for the transmission of the superficial veins of the leg, for absorbents and lymphatic glands. The saphena major vein lies in the substance of the superficial fascia, as it ascends along the inner side of the thigh, to pour its blood into the femoral vein, about two inches below Poupart's ligament. The course of this vein can usually be ascertained by pressure upon its trunk in the upper and inner part of the thigh. Here it approaches so near the artery as to render this knowledge requisite before proceeding to an operation on this part of the vessel.

The fascia lata forms a dense sheath around the muscles, and its presence is readily ascertained during the progress of any operation on the thigh requiring its division.

The femoral artery commences at Poupart's ligament, and terminates at the lower end of Hunter's canal in the popliteal. Its direction is indicated by a line drawn from the central point, between the anterior spine of the ilium and the symphysis pubis, to the inner border of the patella, so long as the foot rests upright on the heel. Underneath this line, the artery will be found at varying depths throughout the thigh. The utility, however, of this rule is restricted to a little beyond the upper half of the thigh, for in the lower half the artery leaves its anterior aspect, and plunges in among the muscles, for the purpose of making its way round the bone into the popliteal region. In the lower half of the thigh, operations on the

artery are comparatively rare, and it is in the upper half, therefore, that the chief interest of this vessel lies, and of this portion the first six inches is the most important. Underneath Poupart's ligament, the femoral artery approaches the skin, lying upon the psoas magnus, about one-third from its inner margin. Its pulsations in this situation are rendered less distinct than they become lower down in the track of the vessel, by reason of the tension of the ligament across it. Below the ligament the artery descends, both in its vertical and in its longitudinal direction, into the hollow formed by the adductor longus muscle, arising from the os pubis and inserted in the middle third of the femur, and the vastus internus, on its outer side, descending in a straight line down the thigh. Here, at an average distance of five and a half inches below Poupart's ligament, the vessel is crossed by the sartorius muscle, which lies upon the artery for some inches. In this part of its course the femoral artery lies, to the extent of about one inch and a half, on the psoas, and from that point, till the vessel reaches the adductor longus, it is entirely unsupported. The femoral vein lies on the inner side of the artery, upon the pectineus muscle, while underneath Poupart's ligament, and occasionally on the bone, when that muscle is smaller than usual. At the distance of two inches below the ligament, the vein begins to pass behind the artery, and in five to six inches the vein is entirely behind it, and it continues in this relation throughout the rest of its course. Two and sometimes three nerves occasionally accompany the femoral artery, one of which, the nervus saphenus, gains its front surface about four or five inches below Poupart's ligament, viz., where the artery is crossed by the sartorius muscle. The saphenus nerve descends in front of the artery to Hunter's canal, there crosses obliquely over to its inner side, and becomes cutaneous on the inner side of the knee-joint.

At a distance varying from one inch and a half to two inches and a half below Poupart's ligament, the femoral artery gives off the profunda, a vessel of nearly equal size to the femoral itself, which descends to its outer side, and subdivides in many secondary branches for the supply of the muscles on the outer and posterior part of the thigh. The femoral artery and vein are surrounded by a sheath of fibrous tissue, which increases in density as the vessel descends. This sheath acquires considerable firmness in the middle third of the thigh, being of a true fibrous character. The last three inches of the femoral artery, so called, lies in the tendinous canal,

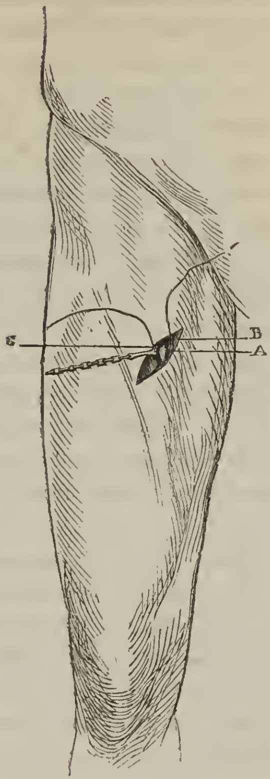
formed by the tendons of the adductor longus, magnus, and vastus internus, having the vein behind and the nervus saphenus in front of it.

The femoral artery is generally tied for popliteal aneurism, but its obliteration by operation is equally required by the presence of any aneurism along its course, as well as by any wound. The part of the vessel usually selected for the ligature is that at which it is crossed by the sartorius muscle, viz., from five to six inches below Poupart's ligament. The reasons why this part of the vessel is chosen are, first, because the distance above the disease, when in the ham, is sufficient to insure the great probability of a healthy condition of its coats; secondly, because it is sufficiently far below the origin of the profunda to insure the formation of an undisturbed coagulum; and, thirdly, because the artery is there readily accessible to the operator. It has been stated that the profunda artery arises from the femoral, at a distance varying from one inch and a half to two inches and a half from its commencement; but we occasionally find this large vessel arising as low as three inches and a half from its parent trunk; and if in such a variety the femoral trunk were tied at a distance of four inches or four inches and a half, the result might prove that the space left was not ample for the formation of a coagulum. In operating on the femoral for popliteal aneurism, it is more prudent to apply the ligature at least six inches below the ligament, where it lies, at some slight distance, underneath the sartorius muscle itself, and not merely where covered by its inner margin.

The thigh should be fully extended, everted, and the knee bent. The course of the artery ascertained by pressure of the finger, and dotted with ink on the skin. The course of the sartorius should also be ascertained by holding the leg in an extended position, and desiring the patient to bend it inwards. This movement being effected by the sartorius, the outlines of the muscle will become apparent. If the deposit of fat be unusually large, a line may be drawn obliquely across the artery, from the anterior superior spine of the ilium to a distance of six inches below Poupart's ligament. The course of the saphena major vein is also to be ascertained, and this knowledge may be acquired by pressure on the vein in the upright position. This line should also be dotted with ink.

These preliminary inquiries being fully made, an incision of little more than two inches in length, in a limb not more than usually in-

Fig. 43.



A. Artery.—B. Vein.—C. Sartorius.

vested with fat, will suffice, and this incision should be made from within outwards, obliquely across the artery, at an angle of about thirty degrees, and across the fibres of the sartorius, care being taken to avoid either the saphena vein or its branches. This incision may be made freely, and the parts divided down to the fascia lata, lying at the depth of about half an inch from the skin. The fascia lata may be divided in the same direction, but for which purpose the knife must be used more cautiously. When the fascia lata is divided, the sartorius muscle is brought into view. Some doubt occasionally arises in the mind of the operator whether the fibres now exposed are really those of the sartorius muscle; but if the line of the incision be correct, they can belong to no other muscle. These fibres should be raised on the inner side of the artery, and hooked, or pushed outwards, when the sheath of the vessels will be

seen below. If the sartorius muscle, as occurs in powerfully muscular subjects, be unusually broad, the distance between the exposed part of the muscle and its inner border may be greater than usual, but that is no reason for dividing it. The operator should work round it to its inner border, which he may do without difficulty, or any important loss of time. The presence of the sartorius muscle is, perhaps, the surest guarantee that the artery is about to be exposed in the best situation, and forms the safest guide to the further progress of the operation. The finger being now applied to the bottom of the wound, the pulsations of the artery will be distinctly felt. The sheath should be divided to the extent of about half an inch, the artery a little separated by means of a silver knife, and the needle passed around it in either direction, care being taken neither to wound the vein, which it is inferred has been sufficiently separated by the previous manipulation, nor to include the saphenus nerve, which, if exposed, should be separated from the outer side of the vessel.

The femoral artery, like other vessels, particularly of the extremities, is liable to wounds, requiring the application of a ligature in any part of its course. Several such examples have occurred to myself. One of these I have mentioned in the introductory chapter to this subject. A second case of this kind occurred to me in the year 1831, while on duty for my late friend, Mr. Earle, which presents peculiarities of interest to the practical surgeon, and which I will briefly relate. A man was brought into St. Bartholomew's Hospital, having received a punctured wound in the direction of the femoral artery while involved in Hunter's canal. The wound was made by a clasp-knife, in the endeavor to open an oyster by placing it between his knees. From the formidable nature of the hemorrhage, and the direction of the puncture, I had little doubt that the femoral artery was wounded in Hunter's canal. Unwilling to perform so serious an operation single-handed, by lamp-light, (for the case occurred during the night,) I put a firm compress on the puncture over the artery, and rolled the limb tightly up to the groin, placing a tourniquet upon the upper part of the femoral artery. On the following morning, a consultation was held, and while discussing the case at the bedside of the patient, the hemorrhage returned with fearful violence, and it appeared that the roller encircling the man's limb was saturated in an instant. The patient was removed to the operating theatre adjoining his ward, and I tied the femoral artery

above and below a large wound in its coats while in the tendinous canal of the adductors. The man was placed in a bed in the same ward from which he had been removed, and progressed for some days favorably. It happened at that time that a severe case of sloughing phagedæna had existed in the hospital. The subject of this disease died, and the ward was whitewashed and fumigated; the remaining patients being dispersed about the hospital. One of these, a boy, had axillary abscess, who was taken charge of by the sister of the ward, and accompanied her to a ward on the ground-floor, to which she was removed Two days after the puncture of the abscess, the boy's wound became phagedænic, and I ascertained that the sister had carried down with her all the apparatus of her calling, in the form of sponges, towels, &c., that she had originally used in the phagedænic ward above. I desired that the boy should be taken again into an upper ward, and kept free from the contact of the patients. Unfortunately, he was placed in the same room with my case of punctured artery. In four days from his arrival, the stump of a case of amputation I had performed ten days prior, became phagedænic; and a second case of Mr. Stanley's in the opposite bed showed the same action, and I removed my aneurism case to the extreme end of the ward; but the man obstinately refused to leave the ward. On the fifteenth day the ligature was firm, but the wound looked glazy, and inflamed round the margin. I desired the house-surgeon to keep a tourniquet permanently around the thigh. On the sixteenth day the ligature came away suddenly, as it seemed, without effort; and on the seventeenth, hemorrhage returned with the same violence as before; two pints of blood were supposed to have been lost before the tourniquet could be tightened. This occurrence also took place at night. The man was pulseless, with the hue of death on his face. In this condition, from which he was rallied only by great perseverance in repeated stimuli and friction, I tied the artery immediately below Poupart's ligament, and above the profunda, having resisted the urgent recommendation of others to amputate the limb at the hip-joint. The man eventually, but slowly, recovered.

THE POPLITEAL ARTERY.

The name popliteal is given to the artery from the point of its emergence out of Hunter's canal, to that of its division into the anterior and posterior tibial. In this part of its course it is inclosed

in a space of a lozenge form, or rather of two isosceles triangles of different sizes, connected at their base. Of these the upper one is formed by the two masses of muscle, which diverge from each other to form the ham-strings. The inner mass, being composed of the semi-membranosus, semi-tendinosus, gracilis, and sartorius, the outer by the biceps inserted below into the fibula. The lower triangle is formed by the divergent heads of the gastrocnemius muscle, and is more nearly equilateral. These triangles are united at their bases. Into this space the artery enters at the upper and inner extremity, passes obliquely to its centre when between the condyles, and retains the mesial line throughout the rest of its course, lying in the two upper thirds in contact with the bone, then upon the posterior ligament of Winslow, and, finally, upon the popliteus muscle. In the upper half or more, the vein lies upon the artery, in immediate contact with it, and a little to its outer side. At the lower end of this space the vein often lies a little to its inner side. The division of the ischiatic nerve takes place usually above the popliteal space, into the popliteal and peroneal of which the inner or larger branch lies superficially to the vessels beneath. These vessels are invested by a well-defined sheath.

The popliteal artery furnishes at least six branches to the knee-joint, and to the muscles of the calf of the leg. For the most part they are all produced from about the middle part of the course of the vessel, and several are sufficiently large to demand consideration in the operation for tying the trunk of the vessel in this situation. Across the popliteal space, a band of fascia, composed of transverse fibres, extends, which is lost on each side in the muscles which bound it, and by which the vessels and nerves are protected from injury. In the straight position of the leg this fascia is quite tense. The popliteal space is for the rest filled up with fat and some absorbent glands. At about the middle of the space the external saphena vein or saphena minor enters, to pour its contents into the popliteal vein.

The popliteal artery, although the most frequent seat of aneurism, is rarely the subject of operation. It is generally affected by disease in that part of the vessel that corresponds with the flexion of the knee. But aneurisms of the bifurcation of the popliteal into the tibial arteries have been described by Mr. Hodgson and others; and for such diseases the operation of Mr. Hunter is almost invariably resorted to; indeed, I have never seen this artery exposed in a case

of aneurism, so universal is the practice of the Hunterian operation, and so especially applicable to this region. With a view to its exposure, the patient should be laid on his face, and in this position, with the leg moderately extended, the outline of the popliteal space is well defined. The course of the artery may be traced over the skin, and the situation of the external saphena vein clearly ascertained. The popliteal artery may be tied in its upper or lower half, viz., either where it lies on the femur, or on the ligament of Winslow and popliteus muscle. In either case the incision may be made in the oblique direction, to the extent of about two inches and a-half. By this incision the skin and popliteal fascia should be fully divided to a sufficient extent to expose the line of the artery lying at the bottom of the wound. The rest of the operation should be performed by a blunt knife, by which the cellular structure about the vessels should be separated, but with as little violence as possible. At the upper half, the connection between the artery and vein is exceedingly close, and they are separated with difficulty. In the lower half, the saphena minor may be exposed, and should be drawn with the popliteal nerve to the outer side.

OPERATION FOR TYING THE ANTERIOR TIBIAL ARTERY.

The anterior tibial artery is deeply placed among the muscles of the front of the leg, where it penetrates the interosseous ligament; it lies at a depth of an inch and a quarter from the surface. Descending, it gradually approaches the surface, and on the dorsum of the foot it is placed immediately under the skin. The artery occupies the front of the leg at the bottom of a deep fissure, formed between the tibialis anticus muscle, on its inner side, and the extensor communis digitorum and extensor pollicis, on the outer side. In more than the upper half of this course the vessel lies on the interosseous ligament; in the lower half, or somewhat less, it lies on the tibia, the increasing breadth of which encroaches on the ligament. The tibialis anticus muscle fills the hollow of the tibia. It arises from this bone, and from an aponeurosis, in common with the extensor of the toes on its upper surface, which covers the fissure between these muscles. In the middle third, the origin of the extensor of the great toe gives a new relation to the artery, which is now placed between it and the tibialis. Reaching the ankle, the anterior tibial passes over the front of the tibia, over the astragalus, navicular and

middle cuneiform bones. In this course it is first crossed by the tendon of the extensor pollicis, and on the foot by the first tendon of the extensor brevis digitorum passing to the great toe.

The anterior tibial artery, as is the case with all the arteries below the knee, is accompanied by venæ comites, having frequent irregular communications with each other, across the vessel. The anterior tibial nerve lies in front of the artery and to its outer side, but in its descent down the leg crosses the artery to its inner side.

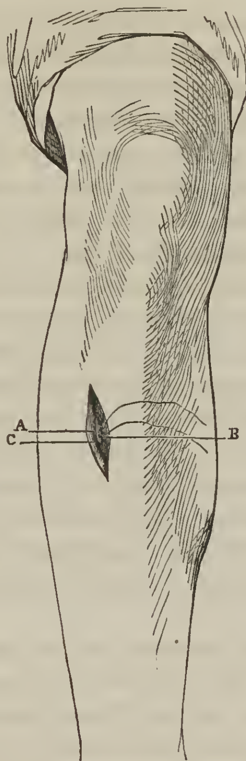
The tibialis anticus is the most important guide to the artery, and its outline should be fully ascertained. This may be done by holding the foot down in extension, previously pressing the toes upwards in extension. By this latter action the common extensor is carried out of the sphere of its action. By then making the attempt to raise the foot inwards, the outline of the tibialis anticus will become apparent. On the dorsum of the foot, the pulsations of the artery are perceptible by careful examination, with the foot elevated. The anterior tibial communicates with the posterior tibial, more or less indirectly, by the terminal branch, descending to join the external plantar, by the external malleolar branch, inosculating with the peroneal, and by other small branches that maintain great freedom of communication.

The anterior tibial artery is rarely tied for aneurismal disease, but the operation is resorted to in cases of hemorrhage from wounds of this vessel, in which two ligatures are necessary. It is an operation of little difficulty, if the anatomical relations of the artery be sufficiently known. The breadth of the tibialis anticus should be clearly defined, on the outer border of which, distant from the tibia about an inch and a quarter in the upper third of the limb, the fissure between it and the common extensor of the toes is found. Along this line an incision should be made, nearly longitudinally, to the length of about two inches and a half, and something more than this, if the muscular development be large. The incision should be made nearly longitudinally; and therefore contrary to the rule I have laid down, in consequence of the depth of the vessel from the skin. If the outer wound be made obliquely across the vessel, then it will hardly be sufficiently dilatable, unless made at very unnecessary length.

The fissure being exposed, the muscles are to be separated from each other by the handle of a scalpel, and the foot is to be pressed upwards in flexion, with the toes extended in the same direction.

At the bottom of the fissure the pulsations of the artery will be felt, and the vessel exposed. The needle should be passed around it, without including either of the veins, if practicable. If it be required

Fig. 44.



A. Artery.—B. Tibialis anticus.—C. Ext. longus digitorum.

to tie the vessel in the lower part of its course, the external incision should be made nearer the tibia; the fissure being now formed by the tibialis anticus and the extensor pollicis, which may readily be detected by putting that muscle into action. It is hardly necessary to say that the nerve should be drawn aside if brought into view. Supposing the anterior tibial to be wounded, either through the substance of the tibialis anticus, or through that of the other muscles on its outer side, it is better on principle, and on the grounds also of greater facility, to follow the above rules, which are unerring, than to attempt a further division of the muscles for the purpose of

reaching the artery. I consider such division of muscles, unless absolutely necessary, to be most objectionable.

OPERATION FOR TYING THE POSTERIOR TIBIAL ARTERY.

The course of the posterior tibial artery corresponds with a line drawn from the centre of the ham to the middle of the malleolus internus. In the two upper thirds of its course it is covered by the muscles of the calf, the gastrocnemius and soleus. In the lower third, emerging from the inner side of the calf, it descends along the inner side of the tendo-Achillis, and is covered only by integument, fat, and deep fascia. In the upper third it is nearly two inches from the inner border of the tibia; in the middle third, one inch and a quarter; and in the lower third, about half an inch. In the upper third it lies on the tibialis posticus muscle; in the middle third, on the flexor digitorum; and in the lower third, either on the tibia itself or on the tendons of the two last-named muscles. It has venæ comites throughout its course, of very irregular and uncertain size. The posterior tibial nerve lies to its *inner* side for about the first three inches of its course, and to its outer side throughout the remainder of the leg below. The posterior tibial artery, veins, and nerve are bound down to the deep-seated muscles, by a layer of tolerably dense fascia, which protects them from the action of the muscles of the calf.

This is the relation of the artery to the surrounding parts; but, with a view to expose the vessel when required, it is necessary to say a few words on the subject of the muscles of the calf. The gastrocnemius arises by two heads from the condyles of the femur, and terminates in the tendo-Achillis, at a distance of two or three inches above that of the soleus, which is inserted into the broad tendon, chiefly on its anterior or deep surface. This latter muscle arises from the inner border of the tibia, and from the fibula. The origin from the tibia occupies nearly half of the length of the bone. In reflecting this muscle from the tibia, the origin of the long extensor of the toes should be carefully avoided, because it forms a guide to the level of the artery. If the fibres of the extensor be raised with the soleus, the dissection will be carried on between the artery and the bones, instead of directly along the surface of the fascia. The saphena minor vein ascends along the middle of the calf of the leg, to join the popliteal vein in the ham, and this vein

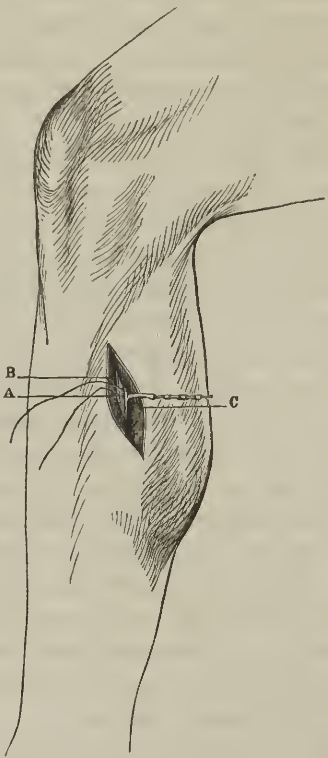
is accompanied by a considerable branch of the posterior tibial nerve. Both of these objects lie in the fissure between the two fleshy bellies of the gastrocnemius muscle.

Although nearly beyond the pale of liability to true aneurismal disease, the posterior tibial is the object of occasional operation. Its large size and its profound depth also render it a vessel of peculiar interest to the operating surgeon. To expose it in the upper part of its course, requires the performance of an operation that may reasonably be termed difficult, and the more so in proportion as the operator has taken less pains to perfect himself in the relative anatomy of the vessel. Descending in the very centre of the leg, bounded posteriorly by the immense and fleshy muscles of the calf, it appears to defy the art of the surgeon in his attempt to arrest hemorrhage from a wound in its coats. The posterior tibial may be exposed in either one of two directions: first, by a deep incision through the calf of the leg; and, second, by an incision along the inner side of the tibia, by which the muscles of the calf shall be raised from off it. In favor of the first of these operations, the name of Mr. Guthrie may be quoted, who has had larger opportunities of testing the value of operations of this description than fall to the lot of most surgeons. Mr. Guthrie recommends an incision through the muscles of the calf, of considerable length, down to the artery. This incision must be made in the centre of the gastrocnemius and through the soleus muscle, the patient being laid on his face, or nearly so. Each muscle must be carefully divided, and at the bottom of a wound so made, the artery and nerve lie covered alone by the deep fascia of the leg.

The other operation for tying this artery in the upper third of its course, and that more frequently resorted to, requires the separation of the soleus from its origin in the tibia. For this purpose the patient should be laid upon the side and the knee bent, the origin of the soleus clearly defined, and the course of the saphena major vein ascertained, and to be avoided, if possible. If, however, the vein or any of its branches should be found to cross the required line of division of the skin, it must share the fate of the integuments, and be divided with them. An incision, varying in length from three and a half to four and a half inches, or even longer, in proportion as the calf is large, should be made, commencing below the head of the tibia, and carried obliquely backwards, and terminating at a distance of full three-quarters of an inch *posterior to the inner*

edge of the bone. The parts exposed should be divided until the origin of the soleus is clearly brought into view. This muscle should then be separated at its origin from the tibia, to the extent of three

Fig. 45.



A. Artery.—B. Origin of Soleus.—C. Soleus, &c. drawn backwards.

and a half inches, or more, care being taken to leave the deep fascia attached to the tibia. It is highly important, in this stage of the operation, to distinguish and separate the fascial surface of the soleus muscle from the deep fascia separating that from the deep-seated muscles. If the heel be now drawn upwards by full extension of the foot, the muscles of the calf will be relaxed, and should be drawn outwards by two fingers forced underneath them. Supposing the wound to be too small to reach the vessel without difficulty, it should be enlarged in either the upper or lower direction. This being

effected, the artery will be felt about midway across the calf, and while lying on the tibialis posticus muscle.

But the proximity of the veins and nerve to the artery demands free incisions, and a sufficiently wide opening, arising from the necessity of dividing the fascia covering it at this depth. It should be recollected that the posterior tibial nerve is internal to the artery for some three or four inches down, and that it lies *upon* the artery for an inch or two still lower. The fascia should be divided while the calf is drawn from the bones by an assistant, the knee being fully bent on the thigh, and the foot as fully extended on the leg, and the artery brought clearly into view. As this operation is generally resorted to in the case of wounds, a double ligature is required; and these should be applied separately around the vessel, unless the difficulty of surrounding the artery be very great; but, considering the tendency in wounds in the coats of arteries to gape, it is always preferable to apply two single ligatures to one double one, the threads of which have to be separated from each other to a considerable distance, longer, indeed, than it has proved feasible to separate the artery from its surrounding tissue. The operation being completed, the soleus should be replaced, and the leg placed on a pillow in bed, still retaining a partially bent position. By these means the soleus will recover its attachment to the bone.

In regard to the respective merits of these two modes of exposing the posterior tibial artery in the first part of its course, we must take into consideration, first, the facility of effecting the primary object of the operation, viz., the arrest of hemorrhage, and, second, the question of the restoration to health of the structures divided by the knife. With regard to the first of these questions, much will depend both on the experience of the operator in the use of the knife and on his intimate knowledge of the region he is about to operate on. Some consideration is also due to the size of the calf of the leg in the subject of the operation. When the calf is large, the distance of the artery from the surface is nearly equal, if measured vertically to the centre of the calf, or to the inner border of the tibia. If the artery were divided by a puncture vertical or nearly vertical, along which a probe would pass down to the vessel, it might be a temptation to follow the line of puncture. The artery here lies in the middle of the leg, and it must be recollected that, although the gastrocnemius muscle may be divided in the centre *between* its two fleshy bellies, yet the soleus, a non-symmetrical muscle, is fleshy in

substance throughout its entire breadth. It is easier by far to follow the line formed by the surface of a fascia than to expose its surface by vertical incision through muscle. There is every difference between the exposure of the fascia lata, for example, through integument and fat, and that of the deep fascia of the leg through muscle; and I conceive that it would be less difficult to reach the line of this fascia from the tibia, and to follow it outwards, than to reach its surface from the calf, because, being very thin, it might be unconsciously divided at the bottom of a wound discolored by blood, when the dissection would at once extend into the deep-seated muscles beneath it, and it should be recollected that muscles divided by the knife bleed freely. The objection to the posterior operation consists in the necessity of making a long and deep division of large and important muscles, which, although made in the direction of their fibres, is calculated to endanger their future integrity of action as well as of structure, and on the entire recovery of which depends the future gait of the individual; for, although a complete and early union of the entire wound may be unattended with evil, yet this union may be slow, or it may be imperfect, consequent on inflammation or on suppurative action being established in the course of the treatment. Should such results follow the operation, the function of these muscles may be impaired for life, and permanent lameness follow. The objection to the inner operation consists in the inextensible nature of one-half of the wound made to reach the artery, and the difficulty of sufficiently drawing back the muscles to reach the requisite depth. Still this evil may be obviated by the first incision being made ample in length, *behind* the line of the tibia, and oblique in direction, and also by position, the foot being fully extended, and the knee much bent on the thigh. On the whole, while I cannot consider the difficulties attendant on the inner operation to be greater than those of the posterior one through the calf, I am disposed, under all circumstances, to prefer it, considering the greater liability to subsequent injury to the actions of the calf by the latter operation. I have done the inner operation on several occasions, both by day and by lamp-light, and I have not found the difficulty by any means insuperable.

The operation for tying the posterior tibial in the lower half of its course is comparatively simple. In the middle of the leg the artery lies on the common flexor of the toes, at a distance of about one inch or more from the inner border of the tibia. The soleus muscle is

attached to the bone, somewhat below the middle, and therefore its separation from the tibia may be required in an operation on the artery, midway down the leg. In the lower third the artery lies on the tendons of the common flexor and tibialis posticus muscles, at a distance from the inner border of the bone of about three quarters of an inch.

In this operation the external skin, fat, and deep fascia alone require division, by an oblique incision over the course of the artery which lies at the depth of about three quarters of an inch from the surface. In passing behind the inner ankle the artery lies behind

Fig. 46.

A. Artery and venæ comites.—B. Tendons of tibialis posticus and flexor digitorum.—C. Nerve.—D. Flexor pollicis.

the tendons of the two last-named muscles, accompanied by its venæ comites, and having the nerve on its outer or peroneal side. Keeping in mind these various relations, the posterior tibial is readily exposed in any part of the lower third of its course.

It is important that the relations of these various structures above and behind the malleolus internus should be well understood in refer-

ence to the operation of tenotomy for talipes varus. The close proximity of the tendon of the tibialis posticus to the artery diminishes above, and we therefore select a distance of an inch or two above the ankle-joint for the safe division of the tendon of the tibialis posticus. No doubt the artery has been frequently divided in this operation.

OPERATION FOR TYING THE PERONEAL ARTERY.

From its origin, the peroneal artery, passing outwards at a very acute angle with the posterior tibial, towards the fibula, and reaching the level of the origin of the flexor pollicis muscle, passes underneath it, along the line of the attachment of the interosseous ligament into the fibula, and it terminates below by inosculations, both in front and behind the outer ankle, with both anterior tibial and plantar branches of the posterior tibial arteries. The peroneal artery, therefore, lies in a groove formed by the fibula, flexor pollicis, and interosseous ligament.

Difficult as the exposure of this vessel may be, the attempt to tie it at the point of injury is preferable to the performance of the operation for obliteration of the femoral or even of the popliteal artery.

The outline of the fibula being clearly marked, an incision of four inches in length should be made obliquely downwards, behind it, to the extent of three and a half or four inches. This incision should be made behind the peronei, which envelope the outer side of the bone. The object next to be accomplished is that of separating the soleus and its tendo-Achillis from the last-named muscle, by which the flexor pollicis muscle is exposed to view. The great toe being as much bent downwards as possible, the flexor muscle should be encircled by the finger introduced into the wound for this purpose. The finger being passed around the muscle to its inner side, the muscle should be drawn outwards and forwards, and detached from the interosseous ligament, underneath which the artery will be felt. It may occasionally, when the muscle is large, be a preferable course to separate the flexor pollicis from the fibula, and expose the artery without separating the muscle from the interosseous ligament, or, if necessary, the muscle may be divided across.

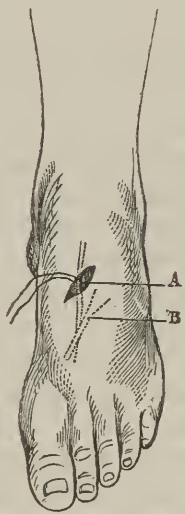
In the case of a punctured wound entering the leg on the inner side, followed by hemorrhage, the source of which may be uncertain, whether derived from the posterior tibial or peroneal, the operation

for tying the posterior tibial artery should be performed. If the artery be found entire, and the evidence point, as it necessarily would, to the peroneal artery as the source of hemorrhage, the wound should be increased to a sufficient length to permit the wounded peroneal artery to be exposed from its inner side, by pushing back the flexor pollicis muscle, and separating the superficial from the deep-seated muscles of the calf.

DORSAL ARTERY OF THE FOOT.

The dorsal artery of the foot may be readily exposed by an oblique incision of an inch in length, commenced on the outer side of the extensor tendon of the great toe. Here the pulsations of the

Fig. 47.



A. Artery.—B. Tendon.

artery are generally felt with distinctness. A little below the middle of the foot, the dorsal artery is crossed by the first tendon of the extensor brevis ; an oblique incision cannot fail to expose the artery to view.

EXTERNAL PLANTAR ARTERY.

The external plantar artery passes obliquely outwards from the inner to the outer side of the foot, where it lies beyond the outer edge of the middle portion of the plantar fascia.

In order to expose it, an incision should be made nearly across its course, taking the inner side of the metatarsal bone of the little toe as the starting-point. From this point an incision of about one and a half inch in length should be made in the direction of the ball of the great toe. The artery, imbedded in a good deal of fat, will be found at a distance of about half an inch from the inner side of the bone, close to its articulation with the os cuboides.

ON ERECTILE TUMORS AND NÆVI MATERNI.

By the term nævi materni is understood a mark, or spot, or mole on the skin of a newly-born child, formed by a mere dislocation of the skin. Erectile tumors, to use the term in its general sense, consist in a congeries of vessels, which have been supposed to possess some form of local action of their own, independent of the general circulation. While by the term erectile tumor we include a form of disease that may originate in any part of the body, and present itself at any period of life, and is often malignant in structure; by the term nævi, we express a local derangement of vessels incidental to infancy.

Nævi are either cutaneous or subcutaneous. The cutaneous nævi consist of dilated capillaries, while the subcutaneous forms are composed both of dilated arteries and veins, of which the latter predominate in a very marked degree. As the disease advances, these enlarged veins become more and more dilated, and form cells which communicate freely with each other, in which the venous coats are generally easily recognizable. Probably capillaries also enter into their composition, the presence of which is indicated by the nearer approach to the arterial color in any given tumor, and by the greater or less rapidity with which the condition of the tumor responds to the increased action of the circulation; and by the greater or less activity of the growth of the tumor. Sometimes

they are so indolent as to remain stationary throughout life, without undergoing any perceptible increase in size; and when occupying a part of the body concealed by the dress, there is no excuse for subjecting them to surgical treatment. As a general rule, however, they increase considerably, and may, when favorably conditioned, reach an immense size, as has been stated by many old writers. They may be found in almost any part of the body, presenting the appearance of a cluster of vessels, more or less elevated above the surrounding skin, discolored, of a reddish or purple tinge, and more or less soft to the pressure of the finger. If very soft, they are composed almost exclusively of vessels in which the venous system predominates. If more solid, they are composed of vessels united by a larger proportion of condensed cellular tissue. It is under the first of these conditions that the growth is occasionally rapid, and the hemorrhage serious. When erectile tumors occur on any exposed part of the body, or show a tendency to increase, unless they have already reached a magnitude so great as to preclude the resort to surgical agency, they should be destroyed. To effect this object, many methods have been resorted to with more or less success by eminent surgeons. These tumors have been, by various authorities, extirpated, compressed, insulated from their vessels by tying the arteries supplying them, subjected to ligatures applied around and through their base, and to circular incisions through the skin and blood-vessels around them, cauterization, acupuncture, injections, and vaccination. Of these numerous remedies few have stood the test of repeated experiment.

When an erectile tumor appears on the person of an infant that has not been vaccinated, it would be well to employ this agent as a first and simple experiment; and, if the tumor be not very large, two or three punctures should be made, into which the vaccine virus may be inserted. Should this remedy fail, perhaps the most efficient remedy which remains is nitric acid. Mr. S. Cooper recommends the employment of the diluted acid. The advantage of this remedy is not very apparent, and the cure must necessarily be very tedious and uncertain. I have found the strongest acid that can be obtained the most efficacious. I tried two cases with some nitric acid made by Mr. Taylor, of Vere Street, of some degrees above the ordinary intensity, and the result was very successful. The advantage of the strong acid is that its effects are immediate; that the destructive action is diffused throughout the substance of the tumor,

and the injury to the skin is less considerable than that occasioned by the employment of the common acid of the London Pharmacopœia. This agent, however, should be applied with great nicety and care. The part should be surrounded with many folds of linen, and the bottle containing the escharotic should be brought close to the tumor. The acid should be applied to the nævus by means of a solid cylinder of glass, and pressed on the part of the tumor on which it is intended to be applied, and repeated two or three times. In all probability, that portion will be destroyed, of which evidence will be obtained in the course of a few days, when, if necessary, the acid may be reapplied to the adjoining structure.

The potassa fusa, if pure, is also a good remedy, and is perhaps more manageable; but its influence on the disease, either at the time or subsequently, is not quite so conclusive. Mr. Lawrence generally employs and prefers the potassa fusa to the nitric acid. When time is not an object, and more especially, where it is desirable that the skin remain intact, I have employed for many years the treatment by means of fine seton threads introduced through the body of the tumor. For this purpose, a long and fine straight, or nearly straight needle is employed, by which the thread of silk is passed through the diseased growth, and allowed to remain in the tumor. Each portion of silk is tied loosely over the tumor to its opposite end. A second thread may be passed across transversely, or obliquely, to the first; but chiefly taking the axis of the tumor as the guide. These threads, being tied upon the tumor, are destined to remain within it throughout the term of the treatment. Inflammation and lymph follow the line of their track, till the whole substance becomes condensed and solid, and the disease is gradually absorbed, or the same result is obtained by suppuration. The only instance in which I have known this treatment to fail was in the person of a child of one of the wardens of the model prison, in whom the disease was very large, and equally soft. The child wore the threads unsuccessfully for three months. Usually a month, or occasionally even a few days, will suffice to obliterate the tumor. I have never seen any injurious effects resulting from the presence of the threads; but should such occur, it is hardly necessary to say that the threads should be removed. The part should be covered with some form of dressing or poultice, to protect it against injury. The strong acid above alluded to has also been employed by Mr. Lawrence in St. Bartholomew's Hospital.

It would be needless to enter into the detail of the numerous remedies for erectile tumors that have been resorted to by surgeons of the last and present century, most of them being either inefficient, or in other respects objectionable. The following, however, may be referred to rather for the purpose of warning the reader against their employment. Extirpation, unless wide of the disease, is necessarily attended with copious hemorrhage, and its objection is obvious. Tying the arteries supplying it is next to impossible, and were it possible, would probably prove inadequate to the purpose. Pressure, injections of stimulating liquids, and breaking down the structure by means of a needle, prove equally inefficient, although each of these means is occasionally successful. Tying the tumor by means of a ligature applied around the base.—This mode of treatment is painful, and is productive of a deep cicatrix. It is, however, an efficient remedy when the tumor can be so insulated as to justify the resort to it. The difficulty of insulation is often remedied by the introduction of a needle through the base of the tumor, armed with a double thread. Each thread is to be carried round the corresponding half of the tumor, and tied very tightly. When these tumors are situated on an exposed part of the body, it is especially important that that remedy should be selected which is least likely to leave behind it a permanent and unsightly cicatrix.

CHAPTER VII.

VENESECTION AND ARTERIOTOMY.

VENESECTION.—RELATIVE ANATOMY OF PARTS AT THE BEND OF THE ARM. —OPERATION OF VENESECTION.—THROMBUS.—LESS RARELY THAN FORMERLY RESORTED TO.—LOCAL CONSEQUENCES.—ARTERIOTOMY.

THIS operation is most commonly performed on one of the veins at the bend of the elbow,* sometimes on the external jugular, and

Fig. 48.

Front of right elbow.

occasionally, though very rarely, on other veins. In order to obtain an ample current of blood, it is necessary to compress the vein be-

* If no particular locality be mentioned, the bend of the elbow is always understood.

tween the opening and the heart; the return of blood being thus arrested, the vessel becomes distended, and when punctured the blood escapes in a sufficiently large stream. In performing this operation at the bend of the elbow, we have usually the choice of three or four veins, the basilic, median basilic, cephalic, and median cephalic (*see* plate); the number, size, and position of the veins, however, vary greatly. Either the median basilic or median cephalic is usually selected; the former is generally the larger of the two, but it lies upon the brachial artery, or rather crosses it at a very acute angle, and is separated from it only by a thin layer of fascia, which passes off from the tendon of the biceps muscle; moreover, one or more branches of the internal cutaneous nerve cross over it. The median cephalic, although smaller, is free from these objections, the cutaneous nerves passing beneath it. But, if the operation be performed with care, the artery may be easily avoided; there is no excuse for wounding it. The young student may avoid all risk by selecting the other vein, which will generally be found to answer the purpose.

We are generally recommended, if possible, to avoid the selection of a vein on which the operation has been already performed. I doubt much if this advice be given on sufficiently valid grounds.

But the arteries also are subject to variety, and we must ascertain by the pulsation that no irregular branch lies underneath. A piece of tape or riband, about a yard and a half in length, and at least an inch broad, is secured round the arm, about three inches above the elbow; it is applied sufficiently tightly to arrest the circulation in the superficial veins, but not tight enough to interrupt the passage of the blood through the artery; this point is ascertained by feeling the pulse at the wrist. The patient is then directed to close his hand; by putting the muscles into action, the blood is thrown into the superficial vessels; or he may at the same time support the arm by grasping the border of the operator's coat: a broom handle was formerly employed for this purpose. The arm being extended at right angles from the body, the front surface is turned forwards: it is much better to do this before the puncture is made, so that the position of the arm may not require alteration afterwards, for it often happens, as the result of a slight twist in the arm, that the apertures in the skin and vein no longer correspond, and the flow of blood is thus more or less prevented.

A third person being prepared with the vessel to receive the blood, the surgeon holding the lancet with the blade at right angles to the

handle, between the thumb and forefinger of the right hand, (for the right arm, and vice versâ,) places the thumb of the left hand upon the vein, just below the spot where he intends to open it; this fixes the vein, and prevents it rolling from under the lancet, which it is otherwise very prone to do, when quite superficial. The escape of blood is moreover controlled, should the vessel be inconveniently placed for its reception. He presses the lancet by a sliding movement into the vein, and by then raising the point he makes the instrument cut its way out, by describing the segment of a circle.

The vein should not be opened in the exact direction of its long axis, but rather obliquely; by which means the edges of the wound will separate more freely. A sufficient quantity of blood having been allowed to escape, the surgeon arrests the current by placing his thumb upon the vessel below the wound, and he immediately loosens the bandage. A small thick pad of folded lint, about an inch square, is then placed upon the wound, care being taken to bring the edges in close contact, and it is then secured by the bandage applied in the form of the figure 8, the ends being made to cross upon the pad. The patient should be directed to keep the arm quiet at first. The bandage may be removed in about thirty-six hours.

In very fat subjects, particularly in women, the superficial veins are sometimes not visible; friction with the palm of the hand along the surface of the forearm will often assist in rendering them more prominent; immersion of the arm in warm water is rarely employed, but the plan may be tried, if the necessity for venesection be urgent. As a last resource, one of the veins on the back of the hand may be opened. When the aperture in the skin is very small, or the position of the arm is changed, the flow of blood is often impeded, and it is liable to become infiltrated into the cellular tissue around, forming a soft bluish tumor, called a *thrombus*. The best course to adopt is to untie the bandage, and at once bind up the arm; opening a vein in the other arm if necessary. All attempts to restore the flow of blood by introducing the lancet generally fail, and so long as the bandage remains, the tumor increases. A portion of fat will sometimes plug up the external orifice, which should be removed. Great difficulty is occasionally experienced in obtaining the blood in a sufficient stream; it will sometimes escape over the arm, trickling from it into the basin. A plan sometimes adopted for making the blood flow more freely is to put in action the muscles of the

arm, by directing the patient to close and open the hand. Although the opening into the vein be free, direct, and of sufficient size, and the bandage be properly applied, the blood is not propelled onwards with sufficient force, and symptoms of approaching syncope usually soon become manifest.

We regulate the size of the opening according to circumstances: sometimes it is desirable to produce an impression on the system at the expense of as little blood as possible, and we then draw it in a full stream. At other times it becomes necessary to remove a larger quantity, and we then endeavor to prevent syncope (which necessarily checks the current) by abstracting it more gradually. But it is always very desirable to bleed the patient either in the standing or sitting posture, avoiding the recumbent position, if possible. The occurrence of syncope during recumbency may create considerable difficulty.

This operation is now very much less frequently resorted to than formerly, but the excuse for this practice is unhappily still very abundant. I think we may form a very good idea of the manual skill of a surgeon, by observing him perform this simple, common operation. There is generally no excuse for soiling the dress or bed-clothes; even the contact of blood with the arm may be avoided; and if the bandage become stained, a fresh one should be employed for binding up the arm.

Venesection is seldom followed by any ill consequences; but among other results may be enumerated inflammation of the integuments, or subjacent cellular tissue, terminating in abscess, phlebitis, inflammation of the fascia, inflammation of the absorbents, and neuralgia from a wound of one of the branches of the cutaneous nerves.

The external jugular vein is now much less frequently opened than formerly. Children are generally the subjects of this operation, the veins at the bend of the elbow being less convenient. The opening is made in that portion of the vein which lies upon the sterno-mastoid muscle, it being here less likely to roll from under the lancet. We open the vein in a direction across the fibres of the platysma myoides, i. e. in the direction of the sterno-mastoid muscle. I believe more importance has been attached to this law than it really deserves; indeed, some surgeons (as the late Mr. Cooper*) recom-

* "Surgical Dictionary," Article *Venesection.*

mend the incision to be made in the direction of the fibres. The vein is previously compressed above the clavicle with the thumb, which pressure is on no account to be relaxed till the wound is closed; this is effected by a pad of lint and strips of plaster. The danger of admitting air in a vein is now well understood; and the surgeon would be highly culpable who neglected the exercise of every precaution to guard against this very serious accident.

ARTERIOTOMY.

This operation is usually performed on the temporal artery, the anterior branch being generally selected; but if that and the posterior be too small for the purpose, the trunk may be opened. The vessel is rendered steady by the thumb and forefinger, one being placed above, and the other below the spot to be punctured. The artery is divided obliquely to the extent of half its circumference; there is no necessity for making a preliminary incision. When sufficient blood has been drawn, it is best to complete the division of the artery; future ill consequences are thus in a great measure prevented. A firm pad is placed upon the wound, and retained by a bandage applied tightly round the head. The "nodose" bandage is sometimes employed;—a common bandage, about four yards long and an inch and a half wide, is rolled up into two heads of unequal size;—the intermediate portion is applied over the pad on the artery, and the two heads are carried horizontally round, one before and the other behind, to the opposite temple, where they are crossed and brought round to the starting-point. They are then half turned or twisted on one another, and carried one over the head and the other under the chin to the opposite side; here they cross, and are continued onwards in the same course to the point of departure. These manœuvres being repeated two or three times, the long head is applied circularly and the whole is fixed. The portion extending under the chin is often very inconvenient. The circular bandage is generally preferable. Pressure should be employed for six or seven days. If it happen that hemorrhage is not restrained by these means, and that a false aneurism forms, the vessel must be tied above and below the wound.

CHAPTER VIII.

ON VARICOSE VEINS.

OCCASIONAL EXTENT OF THE DISEASE.—VARIETIES OF TREATMENT.—TREATMENT BY ESCHARS.

THE venous system of the body and more especially the veins of the extremities are liable to swell, to elongate, to become thickened, and to assume a remarkable degree of contortion; the blood coagulates within them, and by this means one or more veins may become obliterated. In this condition they are called *varicose*. The vena saphena is the especial seat of this disease, and not infrequently the veins of the spermatic cord are affected, constituting the variety known under the name of varicocele. Occasionally we find the superficial cutaneous system of the whole body involved. The pain and sense of swelling, the occasional œdema of the extremity, that so frequently attend a varicose condition of the veins of the lower extremity, render the resort to some positive treatment necessary for the comfort, as well as for the utility of the subject of them, and various have been the means resorted to by surgeons for their permanent cure. These veins are liable to rupture, and very copious hemorrhage follows. Temporary relief from this liability and consequent ulceration is afforded by pressure, but the application of pressure is irksome and tedious; it must be frequently readjusted, a large proportion of the force is lost by its adaptation to a part of the surface that does not require it, and its efficacy is, after all, uncertain and very transient, notwithstanding all the care bestowed on its application.

It must be acknowledged that a permanent cure of a case of extensive varicose veins is a great desideratum, and various have been the efforts made to accomplish it. This necessity was felt as far back as the time of Galen, who employed powerful cautery for their removal. Sir E. Home experimented a good deal in his endeavor to cure them, by means of a ligature placed around the

saphena vein, both above and below the knee-joint. But this practice, carried into the other hospitals of the metropolis, proved fatal to a great number of patients, and was at length abolished.

Within the last thirty years those veins that were especially the seat of varix in the leg have been divided across by the knife, and the coagula have been removed from the interior of the vein. Sir B. Brodie adopted the expedient of passing a fine scalpel across the vein underneath the skin, and dividing the vein with as little injury to the integument covering it as possible. But under all circumstances in which the vessel was cut, even the subcutaneous operation of Sir B. Brodie was unattended by success. Many cases of death followed the operation of Sir E. Home, while the partial obliteration of the disease under the improved operation did not appear to command by any means universal success. The liability of these veins, when divided, to assume an inflammatory condition, and to convey its influence to the constitution, giving rise to symptoms of a severe form of typhoid fever, which often proved fatal under the most skillful management, has attached some degree of danger to any operation adopted for the cure of varix, which requires the vessel to be divided or laid open. But no danger attaches to the destruction of the saphena and its branches by means of escharotics, which may be employed in the form of caustic issues, with all confidence, for the removal of varicose veins of the leg. Having tested this practice for many years, and adopted it largely in the out-patient ward of St. Bartholomew's Hospital, and also repeatedly in private practice, I can unhesitatingly say that the treatment is both efficient and safe. In one or two cases the disease of the veins has partially returned at the expiration of three years, or rather a new disease has sprung up in the neighborhood; but, generally speaking, the relief has been permanent, while, with regard to the question of safety, I have never known an example of pain or inflammation, or indeed the least indication of injury done to the venous system, beyond the locality destroyed. The efficiency of this treatment is, I conceive, due not to the destruction of the trunk of the vein merely, but to the safe application of the agent employed to any and every part in which diseased veins congregate.

In looking to the class of persons affected with this disease, we find them, almost invariably, the subject of debility; the heart beats feebly, the circulation is torpid, the extremities are cold; there is a tendency to a greater than ordinary *remora* in the venous currents,

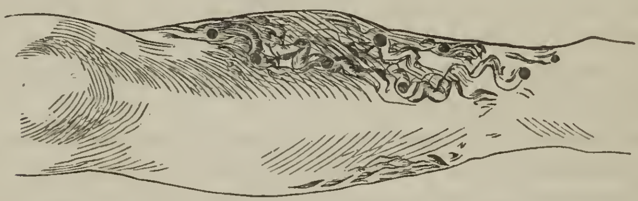
and this condition, so liable to the formation of varices in the lower extremity, is highly favorable to the production of the low typhoid fever, which accompanies inflammation of the veins. Before any local treatment be adopted, an attempt should be made to improve this state of constitution, and to promote a greater degree of vigor in the circulation. Had this principle been carried out in cases of division of the veins, it is very doubtful whether the consequences that have too frequently followed this apparently trivial operation would not have been averted.

The agent I have employed is that of powdered lime and caustic potash, mixed in the proportion of about three of the lime to two of potash, but the potash must be good and fresh. These powders are mixed and made into a paste, by the addition of spirits of wine, at the moment of its application.

Any number of eschars may be made on the diseased veins; I have made as many as nine on one leg at a time, selecting for their application the most prominent parts of the disease upon which the eschar is to be made. The size of these eschars, regulated by that of the aperture made in three or four layers of good adhesive plaster, is of great moment. They cannot well be made too small. I formerly cut an opening of the size of a shilling, but this involved the surrounding skin beyond the margin of the vein, and an ulcer of unnecessary magnitude followed, that was difficult to heal; for in all these cases, consequent on the peculiarity of constitution I have alluded to, the healing action is exceedingly slow. Those that I now employ are less than a fourth part of that size, sometimes but little larger than the diameter of a split pea, the number of which may be regulated by the extent and complication of the disease. The smallest size is sufficient at once to obliterate the vein. Whatever number be made, the entire operation should be completed at once. The region of the ankle may require two, three, or more, placed over the early branches of the vein. One or two may be applied on the trunk of the vein up the calf, and others below the knee. I have made these eschars also above the knee, but not frequently; not because there is any danger attending it, but because the diseased condition of the vein does not appear to require it. When the places for the application of the caustic have been selected, and the plasters firmly fixed, the ingredients of the paste should be mixed and pasted on the aperture within them. A piece of plaster should be laid over each quantity, and the whole may be

removed in from twenty minutes to half an hour. It will then be found that the veins are obliterated; in fact, they have disappeared. Rest in the horizontal posture is desirable, but not essential. In the course of a week or ten days, in a moderately vigorous circulation, the eschars will separate, and the process of healing should then be vigorously pushed, by the aid of bark, wine, good diet, and the local application of adhesive plaster, and stimulants if necessary. Occasionally, the ulcers heal very torpidly, and may occupy many weeks.

Fig. 49.



CHAPTER IX.

ON AMPUTATIONS.

INFREQUENT RESORT TO AMPUTATION A TEST OF SURGICAL SUPERIORITY.—DISEASE AND INJURY.—DISEASES OF JOINTS.—INCISIONS INTO JOINTS. — GANGRENE. — MALIGNANT DISEASE. — HEMORRHAGE. — NECROSIS. — OBSTINATE ULCERS. — COMPOUND FRACTURES. — NO STANDARD OF NECESSITY. — IMMEDIATE AMPUTATIONS. — PROSTRATION OF NERVOUS SYSTEM. — PROSTRATION FROM LOSS OF BLOOD. — REACTION. — AMPUTATIONS ABOVE AND BELOW KNEE. — VARIETIES OF AMPUTATION. — DOUBLE FLAP. — CIRCULAR. — COMPOUND. — STUMPS. — DRESSING OF STUMPS.—TOURNIQUET. — COMMON INSTRUMENT. — OBJECTIONS TO.—IMPROVED INSTRUMENT.—SPECIAL AMPUTATIONS.

The term amputation in surgical language is usually applied to express the separation of any portion, or the whole of an extremity from the remainder of the body. We also speak, not incorrectly, of amputation of the penis or mammary gland. Amputation is the last resource of the surgeon, at once the shelter and the confession of the incompetency of surgical art. The knowledge and the skill of the surgeon fail to cure a disease, and he is reduced to the necessity of removing the entire portion of the body of which it forms a part. If such a disease prove incurable in his hands, he is justified, in obedience to an imperative law of nature, which dictates the desire of prolonged life, in removing it, with a view to preserve the mutilated relic. Strange is it that this power of mutilating the human form—of incapacitating the individual for a large number of the duties of life, and of estranging him from former occupations, which in some form or other alienates him from the society, from the amusement, at least from the pursuits of his fellow-men—should be classed among the most triumphant deeds of the operating surgeon, while it practically illustrates, at the expense of his patient, the poverty and the incompetency of his art. There is no operation in the whole range of surgery compared to that of amputation, that

should claim the previous exercise of an equal amount of skill, of patience, or the decision on which demands so large an amount of conscientiousness. The most experienced are yet but students. As years roll on, crises of improvement occur in our history, which teach us that the advanced knowledge of this year would have rendered unnecessary the operation of the last. Within my own recollection, the operating theatre of St. Bartholomew's Hospital was the scene of weekly mutilations of the frame by the knife, while, at the present day, a little more than a quarter of a century, such operations are reduced to less than half of their former number. Whence this improved and improving condition of the pauper occupants of this single hospital? In the advance of scientific knowledge—in the increased power of contending against disease—in a fuller reliance on nature's power and disposition to cure it;—in other words, in a higher classed surgery; and, I may add, in an advanced sympathy with the sufferings of humanity, and not the least in this category, in the newly-acquired rank of a CURATIVE surgery, which has all but exploded the false eclat incidental to the functions of the operating surgeon, recklessly resorted to on all occasions having a show of reason. The most discreditable operation in surgery is an amputation. It might almost be expected that dexterity in its performance implies a frequent, and if so, an unnecessary resort to it. The important fact should be ever kept in mind, that there is no uniform standard of curative power; a limb that is amputated in one institution is preserved in another. Experience in the treatment of disease, greater care, a patient watchfulness, a high-minded humanity, which identifies the sufferings of others with our own, these are the resources of the first-rate surgeon, and the safeguard of the patient. How often do we lose sight of the necessity of an amputation in the dexterity of its performance, and forget the suffering and deprivation of the patient in our admiration of the manipulative skill of the operator! A decision on the question of amputation of a limb in a large number of examples demands the exercise of the very highest resources of surgical skill, and there needs to us no better evidence of the high standard of surgical superiority in any institution than the infrequency of the resort to amputation.

The operation of amputation is resorted to both in the case of injury and of disease, and in both, the removal of the limb is at the present day *comparatively* rare. The resources of an improved art are successfully applied to the treatment of *disease*, while we are

taught by experience and by reason to place a fuller reliance on nature for the cure of *injury.*

Let us hope that we have not reached the final goal of our improvement, but that we rather extend our confidence yet further in the resources of nature, trusting that the advancing knowledge of the present enlightened age may yet tell profitably for the unfortunate victims of diseases hitherto deemed incurable, and limit our resort to an operation, the frequency of which has ever stamped the records of barbaric surgery, and which yet exists as the opprobrium of our art. Let us not forget that the aim of surgery is to preserve, and not to destroy; and that more real superiority is exhibited in the successful application of skill that retains a limb, than in the dexterity, however great, with which it is severed from the rest of the body.

In order to justify an amputation, whether of a part or of the whole of a limb, the question of recovery by other means must be placed beyond all doubt. Every resource compatible with the means of the patient should have been exhausted. Should any doubt exist in the mind of the surgeon, the patient should receive the benefit of that doubt, and a consultation with one or more eminent surgeons of the neighborhood be held, and in the case of the proposed removal of a limb, the necessity of this final crisis should be clearly established. Then, and not till then, should amputation be resorted to. Presuming that every expedient that skill can suggest has been adopted, and without success, the amputation may be performed.

It is not intended, however, in any remarks that have been made above, to underrate the importance of this necessary operation, to which thousands are indebted for a prolonged life of active utility to their fellow-creatures, or to undervalue the dexterity of its performance; and so long as these pretensions to a superior merit follow in their legitimate position the higher attributes which should ever attach to curative power, they may be unhesitatingly acknowledged to be not only valuable, but to be indispensable to the reputation of a first-rate surgeon.

Amputations are requisite to preserve life from the consequences both of disease and injury. Any disease that is incurable, and the presence of which in the system is a source of such evil or discomfort, or pain, as to render the loss of the limb desirable to the patient, fully justifies the operation. It is important, however, to

distinguish between the warrant of a necessity emanating from *physical*, and that from *moral* causes. The latter, known under the term amputations of expediency—in the French school, amputations *de complaisance*—are justly regarded with an eye of doubt and suspicion, and to be undertaken with much hesitation. (*See* Introductory Chapter.)

Under examples of *disease*, we resort to amputations of a limb in cases of incurable disorganizations of joints, in gangrene of the extremity, in malignant growths or tumors, in copious hemorrhage, the source of which cannot be discovered, in extensive necrosis of bone in a constitution reduced to a state of great weakness, and occasionally in incurable diseases of the skin. In fact, it is resorted to in any form of disease of the extremity, which, being either very difficult or impossible to cure, draws so largely on the circulating, and hence on the nervous system, as to endanger the present or future health of the person affected.

In examples of *injury* from violence, we resort to amputations in severe compound fractures, in greatly comminuted fractures, in which the limb has been crushed under the application of a heavy weight, and in extreme cases of irreducible dislocation; and, lastly, we amputate in distortions, comprising operations of expediency.

I propose to analyze these various forms of apparent warrant for amputation. First, with regard to the disease of a joint, the most important question that arises is that of its incurability. This fact must be clearly established by incontrovertible evidence. Every means and appliance that science and art can command should have been exhausted, without permanent benefit to the affected joint. The judicious resort to absolute rest, local depletion, proportioned in quantity to the strength of the person, counter-irritation in its various forms, local vapor baths, must have failed to mitigate the evil. Disease has so far triumphed, the joint is destroyed, suppuration has been established within its cavity, the ligaments have separated from the bone, the cartilage is partially or wholly absorbed, and the ends of the bone palpably grate against each other. Is this condition of the joint a warrant for amputation, without further reliance on the resources of nature? *Certainly not;* joints are especially sensitive to the consequences of injury or violence, so long as they possess and can exercise the prerogative of health. The joint destroyed by the absorption of its cartilage, and the separation of its ligaments, no longer possesses such powers, and though

lost forever as a movable articulation, may retain a useful existence as an immovable one. Its peculiar susceptibility being exhausted, which in health renders the exposure of its cavity at all times dangerous, the cavity, distended with puriform or whey-like fluid, should be opened by a free incision into it, and the contents evacuated. Tractability of the diseased actions will often follow this comparatively simple expedient, and the limb be saved. I have done this operation on sundry occasions with great advantage, if it be deemed advantageous to save a limb that would otherwise have been removed.

In the year 1838, the leg of a young woman was about to undergo amputation, on account of a disease of the knee-joint of many months' duration. She had suffered a good deal of pain while the diseased actions were going on in the joint, and no doubt was entertained that the cartilage was destroyed. Obscure fluctuation was felt on each side of the patella. I requested permission to take charge of the case, and passed a lancet into the joint on the inner side of the patella, through which about an ounce of whey-like fluid escaped, greatly to her relief from suffering. Within a week I made a second opening with the same result, and this I repeated six or seven times. All pain then subsided, anchylosis followed, and the girl left the hospital at the expiration of three months, with a stiff knee, but with a useful limb. The same result followed this treatment, in the case of a man I attended with Mr. Lobb, of Aldersgate Street, whose knee had been previously condemned to amputation.

Mr. Gay has also adopted this practice with considerable success in several joints, in the knee, the ankle, and the elbow. All these cases consisted in a diseased condition of the synovial membrane, with abscess, such as, indeed, would formerly have appeared to justify the question of amputation. In each case large incisions were made into the joint with perfect success, and anchylosis was the result.

Matter penned up within a joint is a source of great irritation at all times, and although its presence would, perhaps, hardly justify the indiscriminate resort to puncture—for I am by no means convinced that the process of recent suppuration is incompatible with perfect recovery of the articulation—yet in the last stage of disease in which the joint is thoroughly disorganized, there can be no valid objection to the adoption of this treatment, for it is obvious that no harm can accrue to the structure of a joint, an incision into which

would be in no greater degree injurious than in any other region of the body. I believe that a free incision may be often made with advantage, even when matter is not penned up. The size of the incision into the cavity of the joint should depend on the more or less advanced condition of the disease. In early suppuration, especially if the result of accident, or consequent on the removal of loose cartilages, of which I have seen several recent examples, a moderate sized opening would suffice.

Grating of the opposite surfaces of a joint is often urged as an excuse for removing it by amputation. But the destruction of the cartilages, although one stage in the diseased actions, advancing towards disorganization, is equally *to be regarded as a condition essential to recovery by anchylosis*, and if taken by itself forms no justification at all for removal, to say nothing of the possibility of the subsequent investment over the surfaces of the bone of ivory deposit, as it is called.

In recommending the frequent adoption of this practice prior to amputation for diseased joints, I am aware that I may be met by objections founded on the prevalent opinion that the strumous affection of joints, to which the term white-swelling is absurdly applied (in deference to an antiquated pathology), is insusceptible of the adhesive action we here term anchylosis. But I am acquainted with no evidence that warrants this conclusion, supposing pains be taken to remove all sources of local irritation, and to invigorate the system; though I do not pretend to say that such cases give equal promise of success with the former. I have unbounded faith in nature's own resources, and in her good will, to remedy the ill consequences of disease; and I have no doubt that, under circumstances not unfavorable, a sufficiently strong union by anchylosis, or by a fibrous substitute, would reward the surgeon for his experiment.

With these considerations before us, I may venture to conclude that the amputation of a limb for disease of a joint ought to be deemed a rare operation; and more especially when disorganization has resulted from synovial disease.

Secondly. In the case of gangrene of a limb amputation is occasionally resorted to. In the dry gangrene of old age, the early resort to removal by the knife is contra-indicated by the experience of all good surgeons. The very nature of the disease precludes the hope of recovery from the operation, if performed during the period

of progressive advancement. Under these circumstances we have no alternative, but that of waiting the gradual separation of the dead parts, and then sawing through the bone, and making the best stump compatible with the difficulties of the case. Should, however, the diseased actions subside, and give place to a regenerated power in the circulating system of the extremity, indicated by a positive separation of the dead from the living parts, and by the presence of healthy granulations, there can be no objection to the resort to amputation. These objections to the operation do not, of course, apply to that form of gangrene resulting from traumatic causes, in which all the structures of the limb are involved, and in which the circulation is vigorous, and competent to the adhesive process.

Thirdly. The same remarks may be made in cases of malignant disease; in many forms and localities of which, with such tenacity do they cling to a system once invaded, that a question might be raised as to their expediency, especially if evidence be found on inquiry of the existence of disease about the trunk. Unless the disease be entirely insulated by amputation at a distance above it, and often if apparently insulated, the operation will prove futile. The discovery of chloroform is perhaps its best justification.

Fourthly. Copious hemorrhage, the sources of which cannot be discovered. This description of injury was formerly the fruitful source of amputations of a limb, which has happily been rendered a rare occurrence, consequent on a more intimate acquaintance with the relative anatomy of the arterial system. Modern surgery presents so many resources, even beyond that of tying the wounded vessel itself, that the highest discredit would attach to any surgeon, at all familiar with the use of the knife, who should resort to the removal of a limb, before he had explored and examined every possible source of hemorrhage. Still we cannot contend against the evil consequences of the irregular distribution of vessels; and should hemorrhage continue in such a case, after the main artery of the limb were tied as closely as possible to the seat of injury, and in spite of pressure and position, then, undoubtedly, we may be justified in resorting to amputation.

Fifthly. Extensive necrosis of bone, in a greatly weakened constitution. It is not easy to imagine a case of necrosis at the present day that would justify the amputation of a limb; because, if a patient be so greatly reduced to a condition of weakness as to preclude the direct removal of the dead bone, *à fortiori*, he cannot be in a con-

dition to justify amputation. The resort to amputation in cases of disease of the bones has become still more rare since the introduction of chloroform, which has exercised a most beneficial influence over the treatment of this and all similar diseases. Patients formerly lay in our public hospitals for six or nine months, or longer, for the purpose of undergoing the process of removal of the dead bone by internal agency, who now, under the influence of that valuable agent, are brought at once to the operating theatre. In the course of last summer, I removed a considerable piece of the tibia from a patient in St. Bartholomew's Hospital, who, I believe, prior to the introduction of chloroform, would have occupied a bed for many months, before he could hope to have been in a condition to have resumed his occupation.

Sixthly. Ulcerations of the skin, under circumstances of peculiar obstinacy, have occasionally appeared to warrant the recourse to the amputating knife. In such cases it would, I conceive, be more consistent with scientific surgery to destroy the whole surface by escharotics, or even by the actual cautery if necessary, than to amputate the affected limb: better to expose the muscles to the chance of their consequent destruction, were that necessary, than to remove the disease by amputation.

Seventhly. Perhaps the most frequent warrant for the amputation of a limb is that of severe compound fracture or other form of local injury, by which its structure is so extensively torn or destroyed, or likely to be destroyed, in the necessary consequences of the injury, as to point to the great probability that the constitutional powers of the individual will fail in the contest, and death result. Under such circumstances we take off a limb. Unhappily, however, we possess no certain gauge for vital power, and we can arrive at no certain knowledge of the full extent of the injury done. Yet it must be allowed that limbs are preserved at the present day, under frightful injuries that would have been formerly amputated without a moment's hesitation. It would be needless to attempt a general rule, unless we could obtain a perfect knowledge of the extent of the injury; and this is often impossible. Scarcely any amount or form of fractured bone alone would justify the immediate resort to the knife, if taken singly, even supposing the bone fractured extensively into a large joint, for in such a case, although anchylosis of the joint would probably occur, it would prove a lesser evil than that of amputation. Superadded to a compound or comminuted fracture of

bone, the injury may be rendered yet more serious by extensive laceration of the muscles. In considering this latter condition, much will depend on the kind of laceration; whether the muscles are merely cut asunder, or whether contused and torn, and whether this injury involves a few only, or the majority of the muscles of the limb. Again, we must examine with great care the condition of the vessels. Is the main trunk whole, we might ask, in the supposed case of fracture of the thigh? or in that of the leg, is the posterior tibial artery torn? This artery may generally be felt by careful examination behind the malleolus internus. Is the anterior tibial involved? The dorsal artery of the foot is generally perceptible. Is the limb colder than its fellow? Is the temperature considerably lower than the rest of the body? If so, probably one or more arteries are divided. What is the condition of the nerves? Does sensibility extend to the toes? If not, probably the nerve is divided also. Under such circumstances we may obtain a better ground for forming a judgment on the issue, by making slight extension of the limb, and by replacing its lacerated structures in some approach to their natural relations. If the evidence of the integrity of both artery and nerve yet fail, and the sinking temperature of the limb, and the loss of sensibility, continue or increase, we have no alternative but amputation.

The course adopted by different practitioners depends not on any fixed and recognized data, but on the results of general observation, on the greater or less confidence reposed by the surgeon in nature's curative powers, and something, it must be confessed, on his appreciation of the value due to the integrity of the unmutilated body.

Human nature is never without its weakness. The judge upon the bench has his prejudices and his leanings, for human judgment can never become perfect; and so it must happen in the balance to be weighed by the surgeon between retention and amputation of a limb, that some grain of self may be involved. This weakness is not discreditable to the individual, but to the species. The eclat of an operation; the natural and commendable desire to do great deeds; the desire to avail ourselves of the opportunity of instruction to others; or the still more commendable motive of insuring recovery, by a hasty sacrifice of the integrity of the frame; these, and various other agents, are unconsciously interwoven in the decision of the surgeon, as to his conduct and management of the case. If against such influences as these, a higher standard of professional superiority

were established as our guide, based on the soundest physiology, and a yet sterner view of the moral responsibility of our decision; if it should ever become the boast of our profession, not that we had amputated so many limbs, but that we had rescued so many from the knife, then I cannot but express my conviction that the resort to this operation would be yet more rare than it is even in the present era of enlightened surgery.

If a doubt exist in the mind of the surgeon on the necessity of immediate amputation, there is less objection to giving the patient the chance of recovery, by postponing the operation, especially in cases of injury that admit of subsequent amputation below knee, than in subjecting him to the consequences of unnecessary mutilation. Death is a comparatively infrequent consequence of amputation below the knee; while to any ordinary mechanic, the loss of a leg is as fatal to his future employment as that of a portion of the thigh in addition. Mr. Abernethy entertained a strong objection to amputation for compound fracture in the neighborhood of the ankle-joint. Possessing a greater than the average confidence of the profession in nature's power and good will to cure it, Mr. Abernethy showed his superiority, not in his own greater curative power, but in his more profound insight into, and reliance upon that of nature.

Much has been said about the necessity of immediate amputation after compound fracture, &c. The argument for this necessity is founded on the evil of a second shock to the system. But this principle, although good in the abstract, is often greatly misapplied, and as often violated, even by what we call *immediate amputation.* The principle originated from the surgical practice of the battle-field, in which a wounded soldier is brought from the ranks and placed under the hands of the surgeon, either immediately or within a short interval of the occurrence of the wound. But the case is different both in private and in hospital practice, in which some hours from the period of the accident may elapse before the arrival of the surgeon; and I am inclined to believe that, for the most part, the condition of a person with severe compound fracture is favorable for amputation at the expiration of thirty-six or even forty-eight, as at the expiration of three or four. The principle itself is sound, if strictly obeyed; but its rigid observance is incompatible with the ordinary duties and occupations of the surgeon, whether in private or in hospital practice; and I consider that the postponement of all doubtful cases of severe injury to the issue of one or two days' ex-

periment is more consistent with the principles of a higher classed surgery, than the loose obedience to a law, which, however abstractly good, is incompatible with the necessary requisitions of professional life. This argument obtains additional force from the fact that the error, if any, is committed on the side of humanity.

With regard to the question of *reaction* after serious accidents, it appears to me that some error prevails in the professional mind. We do not sufficiently distinguish between the consequences of violence done to the circulating, and that to the nervous system. A man receives a severe blow on the abdomen or elsewhere; his nervous system sustains the first effect of the shock; his pulse sinks till it becomes almost imperceptible, but he has lost no blood. To amputate a limb which may have been fractured or crushed, or otherwise severely and hopelessly mutilated, in this condition of his system, is to hurry him on to his death. The cause is a shock which time can, and under favorable circumstances, will remedy. We give him stimulants, and his circulation rallies; his physical powers revive, and in the course of one or more hours, we amputate, and with success. Contrast this case with that of a man reduced to an equal degree of prostration by *loss of blood*, consequent on severe compound fracture or mutilation of any kind. In such a case, how can we expect reaction to take place with the circulation reduced by a large diminution from its standard quantity?

If the degree of prostration be disproportionately great to the quantity of blood lost, then it is obvious that the nervous system is also involved; and, under such circumstances, we may reasonably anticipate some attempt at reaction under stimuli, and we are justified in postponing the operation for that purpose; but if there exist good grounds for believing the hemorrhage to have been considerable, and it is always difficult to ascertain the quantity lost, we must attribute the prostration primarily to that cause, and resort to immediate amputation. The oozing of blood, in however small quantities, from the circulation of a person greatly reduced by previous loss, is to be regarded as no unimportant addition to the evil already sustained; and we shall watch in vain for any accession of vital power, so long as it continues. In a case, on the other hand, in which the bleeding has entirely ceased, it is easy to imagine that, although we cannot anticipate what is strictly denominated reaction, yet we may rally the power that yet remains by an occasional brief postponement of the operation, and by the employment of

stimuli; but to wait for a rallying circulation, such as in other circumstances would justify the resort to amputation, is to expose our patient to the increased probability of a fatal issue. The amount of blood lost may be generally guessed at by the effect of stimulants, the influence of which will suffice to obtain some reaction in a circulation reduced by the sudden loss of a smaller quantity, but which is inoperative to good, in cases in which the drain has been considerable, and continuous for some hours.

Eighthly. We may be compelled to resort to amputation in extreme cases of irreducible dislocation, but to justify the appeal to the knife, every means should have been exhausted, both ordinary and extraordinary. The failure of the usual means of extension should only dictate the resort to *unusual* means; we must sacrifice the joint for the sake of the limb, as we sacrifice the limb for the preservation of life. The joint should be carefully surveyed for the purpose of ascertaining the nature of the difficulty, and its precise locality. Anatomical knowledge of the joint is here invaluable. The cause of these difficulties in reduction usually depends on the displacement of some partly torn ligament or tendon distorted from its course during the accident, but far more generally on the former. Whatever be the obstructing agent, be it ligament, be it tendon, or be it muscle, it should be divided by means of a fine-bladed knife passed down to it. If necessary to this important object, the skin should be dissected off to an extent sufficient to expose the cause of obstruction; but this, of course, is better avoided if possible. If this principle be fully carried out, if the surgeon resolve to sacrifice the joint or rather to *risk* the destruction of the joint as a movable articulation, amputation will be rarely resorted to in cases of irreducible dislocation.

With regard to operations for distortion &c., or operations of expediency, as they are somewhat inappropriately called, I have only to remind the reader that they are so often followed by serious, and even dangerous results, as indeed are all large operations performed during a condition of the nervous system unprepared for the shock, that they should rarely, if ever, be recommended, and not always resorted to on importunity. (*Vide* Introductory Chapter.)

In cases of severe injury of the leg, or any other cause involving the lower extremity, it is a principle in surgery to amputate below the knee, if possible. This rule, which is so imperative as to give it the

character and importance of a law, is founded not so much on the necessity of preserving as large a portion of the body as possible, as upon the lesser danger of the latter operation. In the operation below the knee, the soft structures constitute a less proportion of the limb, and the bones the greater. The thigh is composed of large muscles, holding a more elevated position in the economy of the body, with both vessels and nerves equally important, any serious injury to which, the nervous system of a person would take more early cognizance of, than from a similar violence done to the leg below the knee. The chance of recovery, therefore, is considerably greater after amputation, below, than above the knee, however closely to the joint the latter operation be performed. Some ingenuity may be occasionally required in obtaining a flap sufficiently large to cover the ends of the bones; but if it cannot be obtained from one side of the limb, it may from the opposite; or, indeed, a portion may possibly be obtained from each, that will prove sufficient when united by suture; for even this proceeding, objectionable as it may appear, is a less evil than the excess of danger of an amputation above knee, over that below.

Three forms of amputation of the shaft or body of a limb are practised by British surgeons. The first of these, and that perhaps most commonly adopted, is the circular amputation. The second consists of a double flap of the soft structures passing down to the bone; the third is a modification of the two former, consisting of a flap of the integuments, and a circular division of the muscles.

The circular amputation is, or ought to be, performed in the following manner. The skin, if covered with fine hair, often found on all the extremities, should be shaved off; the tourniquet applied over the main artery of the limb; the integuments should be drawn up, and held firmly by an assistant; the surgeon, standing on the right side of the body, and steadying himself with his left hand on the limb, immediately above the part to be divided, and with a view also to enable his two hands to act in harmony, and obey the occasional and uncontrollable movements of the limb, should pass the knife around the extremity to its upper surface, or beyond it, if possible, and commence his incision at the proximal end or heel of the knife, close to the handle, and carry it round the limb in an exact circle. Now, as the length of the blade is only one foot, or fourteen inches at most, and the circumference of the skin is, perhaps, sixteen or eighteen inches, the whole of this circle must be divided at one

sweep of the instrument, while drawn uninterruptedly onwards, from the heel to the point. This can only be effected by applying the blade uniformly throughout its entire length, and giving to every part of it an equal proportion of the work to be done. The force of pressure employed by the hand will depend on the resistance of the parts to be divided. This will be ascertained at once by the operator. If the knife is exhausted before the circle be completed, it must be reversed, and the circle completed by dividing the remaining integument towards the operator. This first incision should reach the fascia covering the muscles, or nearly so; part of the circle may exceed that depth, part barely reach it. This is of little real importance. The integuments and fat varying in thickness in different regions of the body, and in different individuals, from less than a quarter to more than half an inch, are to be divided, and reflected upwards all around, to the *full extent* of the semi-diameter of the limb. They may be reflected to a yet greater extent, in cases in which the fat is firm, and the integument and fat inflexible, or they will not readily adapt themselves to the surface of the bone, without more effort than is desirable. Being reflected upwards, they should be drawn and held firmly in this position by the assistant. This constitutes the entire of the first stage of the operation. The second stage consists in the entire division of the muscles, as high as possible, by a second circular sweep of the knife, which should separate them entirely down to the bone. This is effected partly by the employment of somewhat more force, and partly by address and dexterity. Care should be taken to prevent the muscles forming a fold by the general pressure of the knife before the cutting edge reaches it, or the incision of the muscles will be jagged in this part of the circle. The mass being large and even pendulous, the force required must be regulated by tact. The third stage of the operation consists in the separation of the bone or bones by the saw, a duty of some delicacy. The instrument, being applied to the bone at the extremity near the handle, and the short diameter of the blade held vertically to the bone, is to be drawn firmly and slowly to the point and vice versâ, employing at each stroke the whole length of the instrument, and considerable force of pressure.

During this part of the operation, the soft structures require the protection of a linen retractor, drawn up over them. By this action the femur, which is the firmest bone divided in amputation, may be separated in about six double movements of the saw.

The flap operation is performed either in the transverse, oblique, or vertical direction. It is applicable in amputation of the thigh or upper arm, and is occasionally resorted to in the forearm and leg, but under less advantageous circumstances.

It is a suitable operation where the bone is single, and occupies the centre of the limb, or in which the substance presents a nearly equal thickness all around. It is inapplicable when we have a double bone, because that part of the limb has no centre to aim at, and the proximity of one or other of the bones to the skin renders the future investment of that bone weak and imperfect, where it ought to be especially strong and thick. For this purpose a long pointed knife is used. This knife should be double-edged at the point only, the edge on the back extending to about the length of one inch along the blade. This double flap operation is applicable only to amputation of the thigh or upper arm with their single bone. The operator, grasping as large a portion of the soft parts of the limb as possible in his left hand, with which at the same time he fixes the limb, passes the knife through its centre down to the bone. The point of the knife, still urged onwards, passes, as nearly as possible, around the bone to the opposite side, and then pursues the same course through the posterior half of the limb, emerging at a point, as nearly as can be conveniently made, opposite to that at which it entered. The knife should then be carried obliquely downwards, through the muscles and integuments, to the extent of about three inches below the point of its first introduction. For this purpose a slight and slow sawing motion may be given to the instrument, if requisite to complete the incision. A similar flap is now to be made of the opposite half, corresponding in form with the first. A small portion of muscle will almost necessarily remain on each side, and attached to the bone. This should be divided by a circular movement of the knife, and the bone sawn through as high up as possible, the soft parts being protected by the retractor.

The third form of operation, which is a compound of the two above described, is commenced by an incision through the integuments only, carried downwards in an arched form from the point at which it is intended to divide the bone to the opposite side of the limb. This part of the operation may be performed with a large scalpel. The height of this arch should be *fully* equal to the semi-diameter of the limb, and when the incision is completed, the flap should be reflected upwards to a line corresponding with its base.

A second incision is then to be made through the integuments of the opposite side, similar in form to the first, or the two together may form flaps of unequal size. When sufficiently reflected, the muscles are divided in the same manner as in the circular amputation.

In the selection of the operation to be performed in any given case, the surgeon should keep in mind the future services, if any, to which the stump is to be applied, the duration of time required for healing the wound, the condition of the patient as regards his capability of losing blood with impunity, and the time required for the performance of the operation. The question of physical pain, and, for the most part, that of the duration of the operation, are less significant items in the consideration, since the introduction of chloroform, which, it is hardly necessary to add, should be always administered.

With respect to the future services to which the stump may be applied, it should be recollected that the lower extremity will be still employed as an agent of locomotion, and if the limb has been amputated above knee, the pressure of the whole body in the act of walking is thrown upon the bone, tending to force it through the integument, or whatever material covers it; whereas, in amputation of the leg below the knee, the tibia is bent at right angles, and is supported on a wooden pillar. Also the arm is subject to no such test of the strength of the cicatrix, there being no pressure employed. Under all circumstances, the duration of the curative process is an important consideration. It is an object, therefore, to render the wound as small and as simple as possible. The same remark will apply to the loss of blood, whether during the operation or after it, and if it appears, on inquiry, that in one or other of the above operations, a larger quantity of blood is lost than in the other, the fact may be fairly urged as an objection to that form. One condition is indispensable to every good stump, viz., an ample allowance of integument; integument sufficient in quantity to meet in the centre, or at the side without tension. This consideration is more important than any other in the operation. If an error be committed, let it be that of excess, not of deficiency: no merit can compensate for want of healthy integument; for integument, by which is understood the entire of the structure external to the fascia, and including the fat and cellular tissue beneath the skin, forms the only good investment for the exposed bone.

It is equally a just and a general opinion, that muscular substance is not a desirable ingredient in the formation of the extremity of a stump. The nature of muscular fibre, its contractility, the certainty of its form and of its relations to the end of the bone being subject to change in the course of time, forbid our reliance upon it, however specious, and however apparently suitable may be its soft cushion-like texture for this purpose. Deprived of all antagonism, the fibres gradually contract from the end of the bone, and the more especially those which form the external layer, and have the least connection with it. But while we usually avoid the presence of muscle as an investment to the end of the bone, on which, in the case of the thigh, the weight of the body is almost entirely thrown, yet a good fleshy rotundity of the limb up to the level of the extremity is a desideratum. This form of stump is more suitable for the application of mechanical support than is that more pointed form which the stump will gradually assume if the muscles be divided above the level of the point of division of the bone, and to which the term sugar-loaf stump is not inappropriately applied. It is better that the weight of the body in walking should be diffused over as large a surface as possible, therefore substance is required.

So long as the question of pain formed an important subject of consideration in determining the kind of operation to be selected, that kind was, *cæteris paribus*, the preferable one which was most quickly executed; for, in the calculation of the evils attendant on the removal of a limb, the after discomfort, the greater liability to loss of blood from one or other operation, and the duration of confinement, were deemed to be of secondary importance. But the use of chloroform has changed the question, and dispensing with the subject of pain, we may confine ourselves to the question of secondary evils.

Of all forms of amputation the flap operation is performed with the greatest rapidity—with the greatest eclat. I have myself amputated both the upper arm and the thigh within half a minute. But the question to be asked is, is the flap superior to the circular operation, as regards the great consideration of the real welfare of the patient? Is his recovery more rapid? My own experience would lead me to doubt the expediency of this form, if we take into consideration all the circumstances incidental to the case. In the circular operation, the integuments and muscles are cut through

vertically to the plane of the limb. Arteries, veins, and nerves share the common lot; all are divided directly across. The wound in the muscles is exactly equal to their transverse breadth. The larger arteries are tied; the lesser arteries retract within their sheaths, and cease to bleed. The integuments are brought over the cut extremities of the muscles, and unite to them and to each other by adhesion.

In the flap operation, integuments, muscles, and vessels are all divided obliquely; the arteries cannot, from this circumstance, retract, and a greater number of ligatures are required; the divided flap of the muscles is large, and the two opposite surfaces meet in contact, and form a fleshy investment for the extremity of the bone. Over this mass we have an integumental covering. It is true that the flap operation insures a good stump, so far as regards form; but form is of lesser moment (if of any) than is the utility of the stump hereafter, and I am much disposed to believe that, for purposes of utility, and for power of resistance against pressure, the stump made by the circular amputation will in the end be found preferable. With regard to the vessels, I have repeatedly found the most careful efforts to arrest bleeding, by securing the lesser arteries, fail to accomplish the end. I have known six, eight, or twelve ligatures applied, and renewed hemorrhage has followed within a few hours; and this not once nor twice, but many times. The introduction of chloroform has deprived the flap operation of its eclat, and in testing its entire merits by the side of the circular form of amputation, now that the rapidity of its performance is taken out of the scale, I confess that I think they will be found incompetent to the maintenance of its high reputation.

The remarks which I have made on this subject chiefly apply to amputations of the thigh, and, in a lesser degree, to those of the upper arm; whereas, in the case of the leg, a modification of the flap operation, and also of the forearm, may be adopted with advantage. But these operations will be described in their proper places.

My colleague, Mr. Stanley, of St. Bartholomew's Hospital, who has frequently adopted the flap operation, has almost entirely abandoned it, as have also Mr. Lawrence and Mr. Bransby Cooper. The straight line of union, formed by the cicatrix of the circular operation, forms an objection, though by no means a serious one, to that mode of amputation, the corners or ends of which project in an

unsightly manner, particularly when the substance of the integuments is unusually thick; but this is not an important objection, for in the course of time the central part of the cicatrix retracts, and the extremities become soft and flaccid, and cannot interpose an obstacle to the application of the mechanical substitute for the former limb. Were this evil yet greater than it is, it may be readily avoided by that modification of the two above operations which consists in a double flap of the integuments only. This is really a good operation, and possessing many of the advantages of the other two. It obtains a good form for the stump, brings into contact two opposite surfaces for union, and by dividing the muscles in a transverse direction, permits of the retraction of the lesser arteries within their sheaths. The objection which may be urged against it is the difficulty of sufficiently exposing to the eye the entire circumference of the limb in the act of making the incisions in the integuments, whether these incisions are made transversely, or vertically, or obliquely; but it possesses the great advantage of affording the larger flap to cover the larger mass of muscle, as in the case of a prominent biceps muscle of the upper arm; or, in other words, of adapting the size of the flap to that of the muscle to be covered by it. It is often employed in amputations of the forearm, and is almost imperatively called for in cases of diseased thickening of the integuments, which we find difficult to retract, or rather to evert.

The number of vessels requiring ligatures in amputations varies greatly. In amputation of the thigh, from two to eight or more may be required. But whatever be the number, it is indispensable to the early and well doing of the case, that all bleeding be stopped before the stump be finally closed. When the main arteries are tied, the tourniquet should be removed, and the bleeding of the vessels encouraged. Every surface of the divided muscles and integuments, and every fissure between them, should be carefully examined; if it be determined to bring the edges finally together on the completion of the operation, every bleeding vessel should be tied. But when the tendency to bleed from minute vessels is considerable, when we are compelled to resort to the use of the tenaculum instead of the forceps, and to tie a portion of muscle with every artery, it is often necessary to adopt the expedient of applying a mass of lint, wet or dry, to the open stump, to convey the patient to bed, and to

postpone the closure of the integument until all hemorrhage has ceased.

After a long operation, by which the patient has become a good deal exhausted, it is better to place him at rest, and to expose the stump to the contact of air for an hour or two, by which the entire arrest of the bleeding will be ensured, than to persevere in the examination for bleeding vessels. The necessity which too frequently occurs of opening a stump, in consequence of hemorrhage recurring after it has been closed, requires that the greatest care be taken to tie every bleeding vessel before this final act be completed; and especially is this rule important, in cases in which the integuments are united by suture, the necessary reapplication of which is both painful and injurious.

By some operators the suture is invariably applied as the immediate agent of union of the opposite edges of a stump; and it has great advantages. The additional pain created by their introduction, if the needle be of moderate size and in good condition, is not great, for pain itself is comparative; and in cases in which a patient may have objected to the use of chloroform, or in which its influence may have proved ineffectual, or become exhausted, the lesser pain merges in the greater. The suture is a certain agent in insuring the exact apposition of the two opposite surfaces; and this is an important consideration, and less likely to be affected with nicety by means of plaster, *if the integuments are flabby*, or have been left *in quantity disproportionately great* to the rest of the stump. Again, sutures are more easily removable on the first or after dressing of the stump, than plaster, which requires the limb to be raised from the bed for that purpose, to the great distress and suffering of the patient.

Notwithstanding these advantages, in those cases of amputation in which the integuments are well adapted to the muscles, and also to each other; and also, in which the line of junction of the integuments is made vertically, and not horizontally, so that the stump may be dressed without disturbing the limb, supposing the patient to be placed on his back, I should place my reliance on the employment of good plaster, if either agent be employed singly, the great merit of which consists in the uniform pressure it affords to the stump. By such pressure, all the parts composing it are kept in exact contact, and the liability to suppurative action prevented. Still the presence of one or two sutures in the centre of the line

does not preclude the use of plaster, and the two agents may be often combined with advantage, but under all circumstances in which we feel secure on the subject of secondary hemorrhage, moderate pressure is desirable. But such pressure is not to be obtained by means of rollers, or bandages, or applications, repeatedly doubled about the stump, imitating the duplicatures that invest an ancient mummy. The appliances should be most simple.

Hemorrhage into the cavity of the stump is denoted by local pain, heat, a sense of distension, and the oozing of blood from the intervals of the sutures. As soon as this condition is observed, the sutures or plaster should be removed, the stump opened, and the evil remedied, either by applying a ligature to the vessel, if discoverable, or by exposing the stump for a time to the contact of cold air. The presence of coagula would prove fatal to union by the first intention, and would protract the patient's recovery to a period of weeks. Under any circumstances this evil should be avoided if possible.

A few words may be not unprofitably written on the subject of the tourniquet. The application of the principle on which the tourniquet is employed is as old as surgery. It consists in the adoption of pressure made around the limb from which blood is flowing from the vessels containing it. Nor is the instrument now in general use one degree improved in principle upon that which is resorted to by any casual passer-by, who employs his handkerchief for that purpose, to arrest bleeding from an accidental wound, notwithstanding the discovery of the circulation by Dr. Harvey, or the more recent development of anatomical knowledge in yet later times. But the same apparatus is yet generally employed, although the great discovery of the circulation of the blood proclaimed to the world the important fact that any instrument, whether a tourniquet, bandage, or gird of any kind, employed to compress the main artery of a limb, while under the operation of the knife, as effectually precludes the return towards the heart of all the blood circulating below it, as it arrests the current flowing towards the limb through the main channel. In fact, in the act of removing an extremity, all the blood in the venous system of the limb is necessarily sacrificed, so long as we rely on the agency of indiscriminate and universal pressure. It is an argument of little value, that which justifies the loss of the blood circulating through the extremity, as belonging to that extremity, for, however indispensable may be the blood to

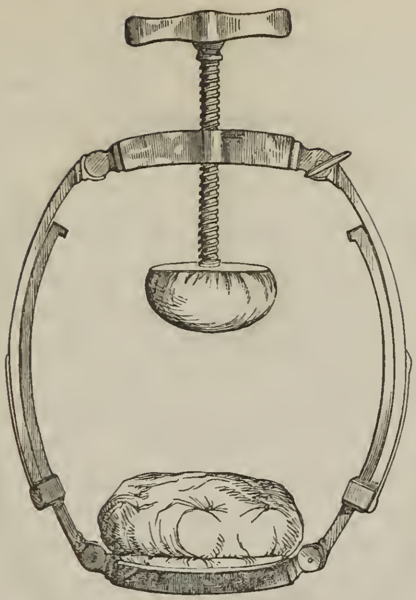
the functions of any part, yet the blood has higher and even more important relations with the centre of the circulation, than with any remote part of the body, such, indeed, as involve the maintenance of functions incidental to life itself. The common tourniquet precludes the return to the centre of any part of the venous blood circulating below it, and the loss of this blood to the heart is at least as important as that of arterial blood; less so to the part, but even more so to the system.

Although the loss of blood consequent on an amputation is rarely felt by the system after entire recovery, as we find by the tendency in persons who have sustained this operation to grow fat, yet the immediate consequences of loss of blood are always more or less severely felt during the period of treatment, and particularly where the hemorrhage has been great. It is, therefore, the immediate and not the remote consequences that are to be avoided, if possible.

An instrument that would compress the main artery, while at the same time it would leave the bulk of the limb free to admit the return of the venous blood, has long been a desideratum in surgery, and such an instrument I have used with advantage. A considerable arrest in the direct channel of the venous circulation must necessarily take place from the proximity of the chief vein to the artery, whether in the thigh or arm; but a large part of the substance of the limb is left by this tourniquet uncompressed and free. This object has of late years been attempted in the construction of the Italian tourniquet, which has the disadvantage of insecurity, and also that it cannot be so applied as to compress the artery against the bone, by which means alone can the pressure obtain a firm base to act against.

The tourniquet which I have substituted is composed of two semicircles, one of which fits into the other by running in a groove. Each half is fixed by a spring catch to the other, and may be enlarged or reduced at will to any size required for the thigh or upper arm. When required for application to the thigh, the circle, which is made to open, to admit of its application around the limb, is drawn out to its fullest size. In the centre of each semicircle is the pad for pressure and counterpressure, the former being provided with the ordinary screw. The pads are made small, in order to include as little surface in the pressure as is compatible with the safe application of the instrument. When employed for a lesser limb, the arm for example, or the thigh of a child, the circle is lessened to the

Fig. 50.

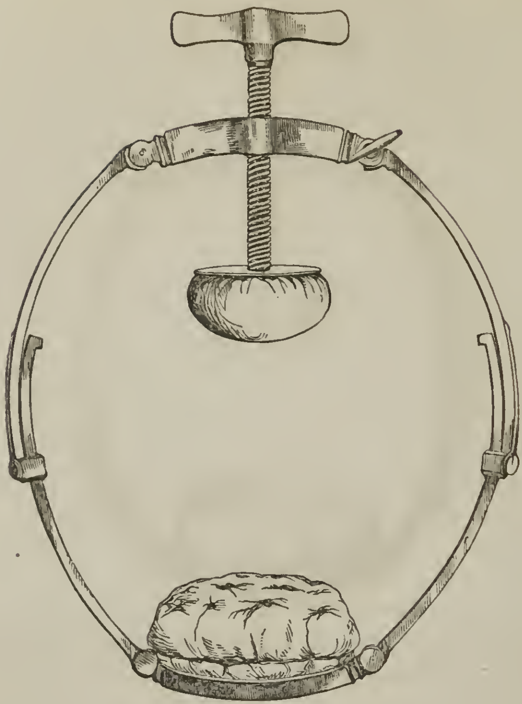


required size by raising the lateral springs, and pressing the outer half or semicircle downwards upon the inner one, by which the large circle is converted into one of smaller size, the alteration being obtained by the introduction of two hinges in each half of the instrument.

I have found this tourniquet exceedingly efficient in its avoidance of the objections to that commonly used, and equally so in its power of arresting arterial hemorrhage. It is also especially applicable to cases requiring pressure for the treatment of aneurism, being less irksome and painful to the patient, when worn for a considerable time. The circulation in the main artery, which is the only one demanding compression, and for which purpose alone, indeed, the instrument is worn, is thoroughly arrested, while the collateral vessels are unaffected, and the current of blood in the venous system, except that of the chief vein, which is in close proximity with the artery, is altogether uninterrupted.

On the day following that of the operation, the stump may be examined generally, but not touched with a view to any alteration of the dressing. On the second day after the operation, if there be discharge from the angles, or from any part of the wound, especially

Fig. 51.



if of an offensive character; if the plasters or dressing be saturated with a sanious or bloody fluid; if the temperature of the limb be high; if there be any evidence of local inflammation, the stump should be dressed. As a general rule, however, except in very hot weather, these indications would not present themselves till the third day after the operation, and then the less distinctly they are marked the greater the probability of complete union by the first intention, for union by primary adhesion must be of rare occurrence in such cases as those referred to. The absence of pain and of heat, the dryness of the wound, the coolness of the limb, the sense of indifference to its being examined, are all favorable indications, and point to early recovery. The first dressing may be undertaken on the second, third, fourth, or fifth day after the operation, according to the above conditions; but under any circumstances the dressing should be partial, and done with a light and gentle hand; and even then it is not desirable to remove all the artificial means of support

to the flap, and most especially if the surgeon have relied on sutures as the connecting agent. If plaster has been used, one or two or more strips may be drawn carefully off, and new strips applied as the first are removed. (*See* WOUNDS, Chapter II.) At the succeeding dressing, the remaining strips should in like manner be changed.

AMPUTATION AT THE SHOULDER-JOINT.

The removal of the upper extremity at the articulation between the humerus and scapula, is happily a rare operation, and can only be justified in cases either of severe laceration of the limb, involving the structure so close to the joint as to preclude the possibility of obtaining a flap sufficiently large to cover the bone, if sawn off below the joint, or from disease, involving the humerus close to the head of that bone. This example of amputation, like that of the hip-joint, presents this peculiarity, that it possesses the material for a large flap, to cover a small exposed bone. The difficulty consists in the liability to retain too large rather than too small a flap of soft parts; but the objection to investing the socket with muscle instead of integument only, does not apply so rigidly to this form of amputation as to others; and considering that the glenoid cavity is placed posteriorly or internally with respect to the acromion, which projects beyond it, it is necessary that we avail ourselves of the muscular structure around the joint, for the purpose of a pad to fill up, in some degree, the vacant space caused by the removal of the head of the bone. Many forms of operation have been suggested and practised by various surgeons for the amputation of the upper extremity at the head of the humerus. I shall content myself, however, with the description of two only, one consisting of a single, the other of a double flap.

Before operating on the shoulder-joint, the surgeon should ascertain that he has means at hand to arrest the circulation through the axillary artery and its branches. This is effected by pressure on the subclavian trunk as it passes over the first rib, above the clavicle; and as it is impossible to apply a tourniquet in this position, the charge of the artery is consigned to a competent assistant, who should ascertain, by repeated trial, that he has the power to arrest the flow of blood through the artery, both in the elevated and in the depressed position of the clavicle. As the immediate agent of pres-

sure, Mr. Guthrie and other eminent military surgeons have employed a ring on the handle of a tourniquet, or a boot-hook well padded with lint. This pressure should be commenced at the moment arterial blood issues freely from the wound, and continued throughout the operation. The pressure required is not very great, even in the elevated position of the clavicle; and as the operation occupies but little time in its execution, there is no excuse for the negligent performance of this important duty. If the pressure be found sufficient, and the assistant express confidence in his power of persistent pressure, during a period of at most two or three minutes, the thumb is the best agent to be relied on, as less likely to move from its position upon the artery; and for this purpose the assistant should stand behind the patient, employing his left thumb for the right artery, letting the palm and fingers of the hand fall over the chest, and vice versâ.

Various forms of this amputation have been adopted by Le Dran, Larrey, Dupuytren, Guthrie, Hennan, and Lisfranc. The merit of the operation consists, first, in the correct adaptation of the flap to the surface exposed, and, second, in its rapid performance. The more frequent plan adopted, and perhaps the most simple for a young operator, consists in making a flap of the deltoid muscle of sufficient size to cover the entire joint.

The patient is seated in a chair, with his trunk supported by an assistant, or by means of a towel passed round the body, and fixed to the chair. If possible, his head should incline backwards on a pillow. The joint being carefully surveyed, the outline of a flap of sufficient dimensions should be marked in ink upon the skin, giving a breadth above, of about four inches, and gradually diminishing below, to that of two inches. The extremity of the arch should not be less than three inches and a half from the acromion process. This flap will be found sufficient to cover the exposed surface without tension.

The arm should be extended at nearly a right angle with the body, and firmly supported by an assistant. The deltoid and integuments should be grasped in the left hand of the operator, and an ordinary catlin, somewhat narrow in the blade, and not less than about nine inches in length, should be introduced through the centre of the muscle, forming an incision which will correspond with the line already marked on the integuments. The lower half of the incision should be first completed, and then the upper half; which is to be

effected by forcing the knife more deeply towards the joint, and underneath the muscle. The joint is opened from above by an inci-

Fig. 52.

sion made into it, and the humerus should then be raised, like a lever of the first order, on the hand of the assistant, supporting it near to the axilla. This part of the operation should be well executed. This movement will tend to force the head from its socket, and to render tense the insertions of the various muscles connected to it. The operator may now, if necessary, change his position to the opposite side of the arm, and, passing the catlin round the head, which is yet raised by the assistant, he cuts through all the structures below, nearly in a straight line into the axilla, leaving a lower and lesser flap, of not more than about an inch in length. In this last incision the main artery will be divided, and it must be secured immediately. Four or five ligatures will probably be required, or even more. The bleeding being fully arrested, the flaps should be united by four or five sutures, and a large mass of cotton wool applied over the entire stump, by three or four broad strips of plaster.

The double-flap operation was first undertaken by Dupuytren, and

is best executed with a short amputating knife. These flaps are somewhat posterior and superior, as opposed to an internal and inferior one. They are rather obliquely placed with regard to each other, and not transversely. A line should be marked, commencing rather in front, but immediately below the acromion process, and carried downwards, inclined backwards across the posterior margin of the axilla, nearly into the centre of that cavity. The second line, commencing at the same point from which the first line arose, pursues a similar course downwards and inwards, across the inner border of the axilla, to meet, or nearly to meet, the former. These flaps should be ample, but not in excess; and when the lines are drawn, the surgeon will be able to form a tolerably correct opinion as to their sufficiency, or otherwise.

The patient should be seated on a chair, as in the former case, and his position secured by a long towel passed around his body, and either held by an assistant, or fixed to the back of the chair.

Fig. 53.

The arm should be raised to nearly a right angle, and held firmly by an assistant. The operator, having previously marked on the skin the lines he intends to follow, introduces the point of the knife below the acromion, and makes his posterior flap, which includes, with the integuments, nearly the entire substance of the deltoid muscle. The flap being held upwards by the surgeon, or by an assistant, the muscles inserted into the greater tubercle are rapidly divided, and the joint is opened posteriorly and superiorly. By then forcing the arm across the patient's chest, the head of the bone is thrust out of the glenoid cavity, and fully exposed to the eye. The surgeon now changing his position, if in the case of the right arm, from the outer to the inner side of the arm, passes the knife across the inner side of the head, and follows, as nearly as possible, the inner line, by dividing the flap, which is opposed to that already made; care being taken that the arm be not drawn too forcibly from the body while the last portion of this incision is being made. I am rather inclined to make this second flap from the skin inwards; partly from the occasional difficulty of passing the knife through the joint, and partly because I think a more certain measure may, by such a proceeding, be taken of the requisite flap. The axillary artery should be immediately tied. It will be found behind the coraco-brachialis muscle.

Both in this and the former operation, a mass of cotton wool should be applied over the flap, when united by suture, to effect steady and uniform pressure of the flaps against the bone; and supposing all bleeding to be arrested, nothing will more fully contribute to an early and healthy cicatrization.

The above operations require comparatively little anatomical knowledge. If the incision through the integuments be correct, all that remains is the division of all the structures that surround the joint. It is a coarse operation, and does not admit of any great degree of skill or dexterity. Bold cutting is its greatest requisite.

Of these two forms of amputation at the scapulo-humeral articulation, neither is very preferable to the other. Perhaps the single flap is the simpler operation, and somewhat easier of execution. I have myself an objection to a single flap of magnitude, when two can be obtained to unite in the middle; for, if it be necessary to re-open the stump, we disturb the divided parts less by separating a double flap formed by two portions of the integument and muscle,

than by raising up the entire single flap. I should say on the whole that the double flap operation was the preferable one, if done well, but it is rather more difficult of accomplishment; and in either case, I may add, that it is an evil to have flaps of too great size, though, of course, not so great or unpardonable an error as to have made them insufficient to meet without tension or effort.

AMPUTATION OF THE HUMERUS IMMEDIATELY BELOW THE HEAD.

This is a more difficult operation to execute than that of amputation at the shoulder-joint; but it possesses the advantage, when practicable, of retaining the head of the bone as a support to the deltoid muscle. By this means, the rotundity of the shoulder is preserved; but not perfectly so, because it must be recollected that the divided deltoid has a very limited function restored to it, and this muscle will gradually waste in form and substance, and display the outline of the acromion process, from which it arises. Beyond this weak argument in its favor, I am inclined to prefer the former operation. Amputation below the head requires the application of the same means of arresting the circulation by pressure of the axillary artery, unless the application of a compress of lint, placed high up in the axilla, and secured by the band of the tourniquet over the acromion, as recommended by Mr. Guthrie, in his work on Gunshot Wounds, suffice for this purpose.

Either a flap or circular operation may be undertaken, and of the two, the former is preferable. The patient should be seated as before; but his head and body must be well supported. The arm being extended, the double flap is made with a small amputating-knife, in the same manner as in the double flap operation upon the shoulder-joint, but with this difference, that it is made two inches lower down the arm; the knife being first introduced at that distance below the acromion, and carried round the outer side of the arm, dividing the muscles that constitute the margins of the axilla, close to their insertion. The axillary artery should be secured prior to the separation of the bone. It would be better to employ a linen retractor, for the purpose of protecting the soft parts from injury from the saw, especially if it be requisite to divide the bone very close to its head.

Sutures will be required. Cotton wool in abundance, and strips of plaster, to effect sufficient pressure on the surface of the stump.

In the circular operation, the subclavian being compressed above the clavicle, the integuments may be divided, as in other operations of this kind. The line selected should be calculated by the necessities of the case. If it be intended to divide the bone immediately below the head, this circular incision should commence at a distance of four, or four inches and a half, below the acromion, and the integuments reflected upwards, including a portion of the deltoid muscle, which will give substance to the flap. In order to prevent the margins of the axillary cavity carrying the skin too widely off the bone, the arm should now be considerably depressed, the reflection of the skin completed, and the muscles divided as high as possible down to the bone; the axillary artery tied, and the bone sawn asunder; a linen retractor being employed to draw up the axillary muscles. The line of union of the flap may be determined by the selection of the moment. It is unimportant whether vertical, transverse, or oblique.

AMPUTATION AT THE MIDDLE OF THE UPPER ARM.

In selecting the form of amputation most appropriate to this situation, it must be recollected that the biceps muscle is usually very prominent on the inner side of the arm, and especially so in the working man. This fact is unfavorable to the flap operation, in which it is obviously desirable that the mass of muscles should be tolerably equal in substance all around the limb, but it is not an insuperable objection, and the operation is often performed with success. But unless executed with peculiar skill, and unless the flaps correspond in form with each other, and in size sufficient, and not more than sufficient, to meet in apposition over the divided bone, no object is attained by its selection; and, as a general rule, the circular operation, although requiring perhaps half a minute longer for its completion, will be found the preferable operation, as far as relates to the period of convalescence.

Pressure on the brachial artery may be effected by the hand of an assistant, especially in an attenuated arm, or by the common tourniquet, applied as high as possible towards the axilla.

If the circular operation be adopted, the separation of the inte-

guments should not be made too great, or the flap will be unnecessarily long; for, unless the arm be very large, they may be drawn up considerably by the hand, in consequence of this loose connection to the chief muscle. If the biceps muscle be unusually large, it should be divided singly, for, if included in the common division of all, it is liable to be pushed forward by the knife, and divided obliquely. By this act we simplify the division of the remaining muscles, we save the skin from liability to injury in passing the knife round the arm through the muscles, and we can divide without difficulty this prominent and insulated muscle a little higher than the rest of them.

In the flap operation, the half of the integuments that include the biceps should be somewhat longer than the opposite one, but the error of excess in quantity is, of the two, the more probable one. Instead of making the flaps by either a vertical or a transverse incision, it is preferable to make them oblique, by introducing the point of the knife, which need not be of unnecessary length, through the centre of the biceps muscle, and giving a portion of the muscle to each flap. This, of course, supposes the selection to be optional on the part of the operator; but if compulsory, in consequence of the mutilation of the parts below, any direction of the flaps will suffice, provided a sufficient quantity of integument be left to cover the exposed biceps muscle. It is desirable to divide the median nerve as high up as possible. The opposite edges may be united by two or three sutures, and by adhesive plaster.

AMPUTATION AT THE ELBOW JOINT.

This operation is effected by the formation of a single flap, obtained from the front of the forearm; but, as it is obvious that there is great disproportion between the thickness of the structures on the anterior and those on the posterior aspect, so some modification of the flap ordinarily made must be resorted to. If the olecranon process of the ulna be removed, and the fact of the insertion of the triceps muscle into it forms but an indifferent reason for the employment of the saw, inasmuch as the functions of that muscle, referring solely to the forearm, are totally destroyed, the thickness of the mass composing the anterior flap will ill correspond with that behind, by reason of the proximity of the ulna to the skin.

Taking the breadth of the condyles for our guide, an ideal flap

should be made, of sufficient dimensions to cover the broad extremity of the humerus when exposed. This line may be marked in ink. The arm should be held or supported nearly in the straight position of the elbow-joint, and the anterior flap cut from the front, by means of a long and strong scalpel, introduced immediately below the farther condyle, be it right or left, and carried round the marked line, terminating at the condyle nearest the operator.

This flap should be made by cutting in a straight direction, but *slanting backwards*, through the fleshy substance in front of the joint, towards the summit of the coronoid process of the ulna. This flap, when completed, will be found of *decreasing thickness from above downwards*, the margin being that of about one-third of an inch. The joint is now opened in front, the lateral ligaments divided, and the forearm pressed backwards with some force. The posterior division of the integument may either be made from the front or from behind. If sufficient integument have been obtained from the flap in front, that covering the olecranon may be removed with the bone, or, if necessary, it may be retained by passing a long thin-bladed scalpel from the front between it and the bone behind, and cutting downwards close to the back of the ulna. But this is a somewhat difficult process. By means of this description of flap, of which I shall speak more hereafter, the apposition of the two surfaces brought into contact will make some approach to equality in size and form. One or two sutures should be used, but I should place my reliance on plaster, and on the influence of its pressure, conveyed through the medium of cotton wool.

AMPUTATION OF THE FOREARM BELOW THE ELBOW-JOINT.

In amputation of the forearm it is, I conceive, always desirable to retain as much of the arm as possible. In diseases of the wrist-joint we remove the arm immediately above it, while amputations higher up in the forearm are executed for the removal of disease, or required in compound fracture. Whenever the option remains to us of selecting the point for removal, we should keep in mind the agency of the muscles which severally influence its movements, always retaining, if possible, such as may be hereafter serviceable. The movements of the forearm are those of flexion and extension, and of rotation by the agents of pronation and supination, and all of such agents may become invaluable to the subject of amputation.

The muscles concerned in the actions of flexion and extension are connected to the bones immediately below the elbow-joint. Next to these, on tracing the radius from above downwards, is the lesser *supinator*, which is attached to it in about its upper third, and on this muscle we must chiefly rely for that position, because the supinating action of the biceps, although great, is confined to the attitude of *flexion* of the forearm. In order to retain the efficient agency of the supinator brevis it must have an antagonist, and following the line of the bone downwards, the first agent of pronation is the *pronator teres*, the insertion of which into the radius occupies, as nearly as can be stated, the middle two inches in the length of the bone, or rather less. If the *pronator radii teres* can be retained, rotation will be perfect, and the mutilated arm be still applied to very useful purposes in life.

The two operations most eligible for this region are the circular and the double flap of the integuments. The objections to the common double flap are based on the proximity of the ulna to the skin on the back of the arm, which renders difficult any correspondence in form and substance between the two opposed flaps, and the impossibility of making an exact junction of each to that of the opposite half. The tourniquet should be applied on the brachial artery, half way down the upper arm, care being taken to compress the artery upon the bone towards the centre of the limb. *In the circular operation* the integuments should be reflected upwards with the knife, to the extent of about an inch or less all round the limb. The operator should be careful to effect this purpose perfectly on the posterior aspect of the arm, when this operation is a little more difficult. The second stage divides the muscles with a light hand down to the level of the bones, and it is completed by means of a fine catlin introduced between them. By the aid of a three-tongued linen retractor, the centre of which is passed through the interosseous space, the muscles, &c., are drawn up with some force, and the bone sawn asunder as high as possible. The bones should be sawn together while on the same plane; if posteriorly in pronation the saw will be held nearly vertically, if anteriorly, the arm will be forced back in supination. In either case the completion of the division of the radius should be first effected, because the ulna, having the firmer connection with the elbow-joint, will better bear singly the action of the saw.

In making the double flap of the integuments, the operator should

make a careful survey of the arm, its form, thickness, &c. The flaps should be anterior and posterior. The point of division of the bones being determined on, an arched line in ink should be drawn in front, from the central point of the radial to the ulnar aspect of the arm, and a corresponding one behind. Commencing at the starting-point, the lines formed for each arch should run nearly longitudinally along the arm, to the extent of about an inch, and then curve almost suddenly inwards, passing nearly transversely across the forearm in this form , otherwise the arches will become pointed, and will not correspond in form. The depth of each flap should be about an inch, or something more. These two integumental flaps being separated up to the line forming their base, and drawn upwards with some force, even beyond it, the muscles should be divided by the circular incision, as in the former kind of operation, and the operation completed by the aid of the catlin, retractor, and saw. The radial and ulnar arteries will be found nearly in front of the corresponding bones, and of the two interossei, one upon the interosseous membrane, and the posterior half an inch behind it. If this operation be well executed, the stump is in all respects excellent. The flaps are united by one or two sutures, the necessity for additional pressure by means of cotton wool depending upon the superabundance of integument.

AMPUTATION OF THE FOREARM WITHIN THE LOWER THIRD.

The objections urged in the last subject against the double flap apply to this locality with increased force, and the additional argument against its applicability is derived from the nature of the structures to be divided, in which tendon so largely predominates. In the attempt to divide these parts from within outwards, unless the knife be in perfect condition, and the action of the hand in cutting be exactly equal to the force requisite, so slight is the resistance to the pressure of the knife afforded by the tendons, that one or more may separate from the remainder, and be divided obliquely, or at least imperfectly; and when the tendons have been so detached and elongated, the fasciculus connected with them will not equally retract with the rest of the muscle. The consequence is that the tendons require a clean division higher up, and this new division becomes quite requisite to prevent the tendon doubling on itself in

the stump. The best operation here, also, is the flap of the integuments, which should be made in obedience to the rules laid down in the last operation; the tendons and muscles may be divided by a circular incision; or, indeed, it is preferable to divide those on each aspect of the arm singly by a straight sweep of the knife. If in this object the knife is employed with a light hand, the tendons will not be subject to dislocation, and the incision will be clean and perfect; for it is an important object to keep the tendons out of the wound if possible. The arteries to be tied will be two, three, or four in number; generally two only require ligatures.

AMPUTATION OF THE HAND AT THE WRIST-JOINT.

This operation should be performed by means of the double flap of the integument only. The starting-point consists of the styloid processes of the radius and ulna, from which an anterior and posterior flap are made, corresponding with a line in front, descending from the same process in a nearly longitudinal direction, to the extent of about three-quarters of an inch, and then carried across the wrist, leaving a slightly convex edge to a corresponding point over the opposite bone. A similar flap should be made behind, and the integument reflected to the level of the articulation, which may be now opened, either in front or behind, by the division of the tendon and the carpal ligaments. In opening the joint and separating the bones, care should be taken not to expose the articular cavity between the radius and ulna, or the movements of rotation will be impaired, if not destroyed. In cases of mutilation of the hand, sufficient integument may be obtained, when necessary, from either surface of the hand, to invest the extremities of the bones. The double flap, as practised by M. Lisfranc, is a very objectionable operation.

When circumstances render it necessary to remove the entire hand, there can be no advantage in retaining the carpal bones, which are insusceptible of movement on the radius, excepting through the agency of muscles, whose insertions are beyond it. There is, indeed, one exception to this fact; viz., in the flexor carpi ulnaris, inserted into the pisiform bone. But this insertion into a single bone can be inoperative to good, supposing the hand to be removed at the distal surfaces of the carpal bones, and amputation at the wrist-joint has less objections than that at the latter

articulation. One objection, quite worthy enumeration, consists in the almost certain exposure, in the carpo-metacarpal operation, of the bursal cavity underneath the flexor tendons. This cavity, surrounded by firm and incompressible parietes, viz., the annular ligament and the bone, which is of large size, remains patent, and may become inconvenient as a secreting surface.

In mutilations of the hand and fingers, it is often practicable to retain one or more fingers, which become hereafter incalculably valuable to the patient. When such mutilations, therefore, present themselves, and they are unhappily common enough in hospital practice, and in all manufacturing districts, the surgeon should pause, and after carefully studying the consequences of the injury, should determine on the practicability of retaining any one or more fingers or even a portion of a finger. It is impossible, unless under such experience as necessity alone can realize, to say to what purposes such an appendage to the hand may not be applied. It would appear that the effects of habit and education have no definite bounds, and that the resources of ingenuity, stimulated by the necessities of life, are boundless in their number and infinite in their variety; and among the occasional triumphs of the operating surgeon, there are few that more redound to the credit of his art than that due to his skill and enterprise in preserving unimpaired a single extremity of a mutilated hand.

In considering the necessities of amputation of one or more fingers, we must be influenced by the general injury sustained. A compound fracture of a single finger does not justify its removal, unless we have evidence of injury to its tendons, or to its vessels and nerves; but the same extent of injury sustained by two or more fingers may justify amputation. If the wound has extended into the palm, and torn, or otherwise disorganized the structures, or infiltrated its tissues with dirt, amputation of the distal extremity of the carpus may become necessary. If it be determined to make an effort to preserve one finger out of the four, it will not be advisable to remove the metacarpal bones at the carpal joint, but to saw them off as low down towards the fingers as is compatible with the injury done.

Of the five fingers, the thumb is less frequently the subject of injury, owing to its great mobility, and it is at all times an important object to preserve it; and, although, from the insulated form of its connection with the trapezium, its articulation with the carpus

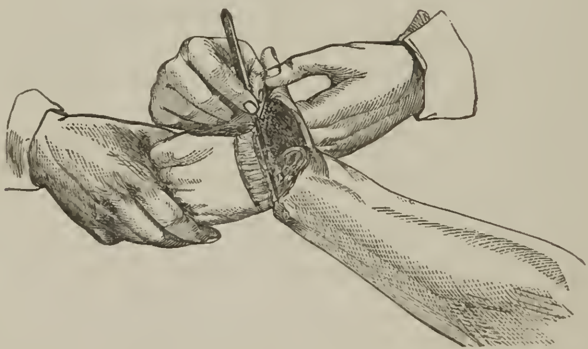
is not necessarily exposed to injury, yet it is safer to saw through the four metacarpal bones, if practicable, than to open the carpo-metacarpal joint.

The line of this articulation may be ascertained by taking the styloid process of the radius and ulna as our guide, which may be felt by making firm lateral pressure on the carpal joint, and from their extremities a transverse line should be drawn across the back of the hand, a finger's breadth and nearly a half below which, will correspond with the line of connection between the carpal and metacarpal bones. If the injury sustained by the metacarpal bones be so close to the articulation as to render it difficult to preserve any part of them, they had better be removed from the carpal joint.

AMPUTATION OF ALL THE METACARPAL BONES AT THE CARPAL ARTICULATION, EXCEPT THAT OF THE THUMB.

The articulation, suppose of the left hand, determined by the above rule, being ascertained, a line is to be commenced on the

Fig. 54.



ulnar side of the hand in pronation, at somewhat more than an inch below the styloid process, and continued downwards in this aspect for a full inch in length. This line, which should then be carried across the hand, in a slight curve, formed towards the roots of the fingers, should terminate opposite, about the middle of the metacarpal bone of the thumb, and at about an inch from the centre of the bone, when in abduction. From the extremity of this line, a second line should be drawn, on extending the thumb, across the fold of integument that connects it to the index finger, which

should be carried round the thumb to its palmar surface, dividing this fold considerably nearer to the index than to the thumb, and continued two inches in length on this surface, parallel to, and at a distance of full one inch and three quarters from the dorsal surface of its metacarpal bone. A third line, somewhat convex from this point, should be formed across the palm to the ulnar aspect, to join the first incision.

At the radial extremity of the first of these three incisions, we must be careful not to divide the tendon of the extensor secundi internodii pollicis muscle; and at the termination of the second incision, we must be equally careful not to divide unnecessarily the upper half of the muscles constituting the ball of the thumb; this second incision should be so made as to leave ample integument to cover the metacarpal bone of the thumb. That which winds around the thumb should pass deeply through the muscles down to the metacarpal bone of the index finger. The flaps on the dorsal and palmar aspect need contain nothing but integument cut fairly down to the tendons both in front and behind. The tendons may be divided in a straight line across the joint, which should be opened on the dorsal aspect; and to effect this, the hand may be forced forwards in flexion. The order or stages of the operation should be, first, the dorsal flap made and reflected, then at once to expose the line of the articulation, and then to proceed with an incision round the thumb, and finally the palmar flap. The reason to be assigned for this order is to enable the operator to rectify, by his final flap, any imperfection due to the first.

AMPUTATION OF THE THUMB AT THE CARPUS.

The point of articulation between the metacarpal bone and the trapezium is to be found a finger's breadth and a half below the styloid process of the radius, and it should be marked with ink. The line of the proposed division commences about half an inch above this joint, towards the carpus, and may be well represented by a loop of string encircling the thumb loosely, and employed for the purpose of drawing forcibly the thumb backwards in abduction. The knot of the loop will then correspond with the little fossa formed on the dorsal aspect of the thumb by the tendons of the extensor primi, and secundi internodii pollicis muscles. The thumb should be forcibly abducted, and being held in this position by the

operator, a long scalpel should be passed down close along the front of the articulation of the head of the metacarpal bone with the first phalanx, commencing at the fold of the integuments. This incision should be made closely along the bone, and of about one inch in length. Each end of this incision should then be brought, by a gentle sweep round, to the dorsum of the bone, and approaching each other, should meet *on the metacarpal bone*, about half an inch below the joint from which the thumb is to be removed, and carried *beyond* the joint in a straight line. The extensor tendons being divided, the articulation may be opened, and the remainder of the muscles detached from the bone in bending it forwards. If the first incision be carried lower down than the length indicated before the line be inclined backwards, an insufficient covering of integument may follow.

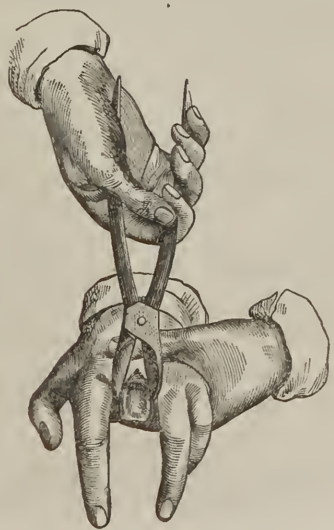
AMPUTATION OF THE LITTLE FINGER AT THE CARPAL JOINT.

This operation corresponds very much with that of the last described. To ascertain the situation of the joint, we may take the *tubercle* on the back of the ulna as our guide, which is more prominent than the styloid process of that bone. Below the tubercle, measure one inch and a half along the direction of the little finger, and we make a sufficiently close approximation to the joint. Apply the same loop of string or flexible wire around the finger, but smaller than that applied around the thumb, so that the incision along the upper or carpal half of the metacarpal bone shall be single; in other words, the sides of the loop should gradually converge and meet about half way down the bone. For the operation the finger should be drawn inwards, and a narrow and long-bladed scalpel passed close to its inner side, along the bone, to the extent of about an inch. The ends of this incision should then be brought round with a gradual sweep on to the ulnar surface, and continued singly above the articulation. The muscles and tendons should be separated from the bone, and the articulation opened, care being taken not to injure that of the second finger, and the bone be then detached. The same operation will apply to the removal of either the index or little finger from its metacarpal bone. We should, however, recollect, that the head of the metacarpal bone is large, and requires an ample quantity of integument to cover it.

AMPUTATION OF THE SECOND OR THIRD FINGERS.

The point of articulation between the first phalanx of the fingers and their metacarpal bones is palpable enough on the dorsal aspect of the hand. In order to find the corresponding points on the palmar surface, we may take nearly an inch along the palm for the middle and ring fingers. While amputating the fingers, we frequently remove also the head, and about one inch of the shaft of the metacarpal bone that supports it. This addition to the operation retains for the hand some approach to its original form, and removes, in some degree, the deformity incidental to the loss of a finger. But before its removal the surgeon should ascertain the nature of the pursuits of the individual, inasmuch as the integrity of the palm may be more valuable to him than the absence of deformity. It is not suggested that the surgeon should consult with the patient on the proposed removal of the head of the metacarpal bone, but that he should simply ascertain the nature of his occupation before removing it, and form his best judgment on the expediency of doing so. This operation requires some nicety in its execution. The line of division of the parts is well defined by a loop of string, of three inches in length, when drawn tightly. To each opposite end of this loop attach a piece of string, and place the loop over the finger, draw-

Fig. 55.



ing the ends tight on the palmar and dorsal surface, and this loop will indicate the line to be divided by the knife. The instrument employed should be a scalpel, rather narrow in the blade. While making each section with the knife, the corresponding finger should be drawn asunder, *on one side at a time.* If the middle finger be the subject of amputation, the index should be drawn from it, and the knife introduced close to the finger to be removed, cutting down to the articulation; the blade is then to be inclined with a curve backwards, corresponding with the line of the cord, and continued for three-quarters of an inch along the centre of the metacarpal bone, and in like manner, completed in front *to the mesial line only.* The opposite section should be made in the same manner as the former, while drawing asunder the ring finger, the tendons divided high up, and the bone, when cleaned of its interossei, divided by the bone forceps, held vertically. Occasionally an artery may require a ligature, but not generally. A roller applied around the palm of the hand is often sufficient for the purpose of bringing the cut edges together; but if lateral pressure does not effect this important object with precision, one or two sutures on either surface may be resorted to. Arrest the bleeding before bringing the edges together.

AMPUTATION OF THE FINGER AT THE ARTICULATION OF THE PHALANGES.

Four kinds of operations are occasionally performed for this purpose. The first has the flap made from the back; the second, from the front surface; the third takes a flap from both, and the fourth is made with lateral flaps.

If a flap be made from the dorsal surface of the phalanx to be removed, it should be ample in size, for the exposed head of bone is larger than it appears. The point of a scalpel is introduced down to the bone, beginning at the middle of the lateral aspect of the finger, and carried downwards, first, longitudinally, and then almost transversely, nearly as low as half way down the phalanx. This flap is to be reflected up to the joint. The finger is then bent, and the joint opened, the lateral ligament divided, and the knife passed straight through the opposite skin, the posterior flap being sufficiently long to cover the end of the bone.

The second operation is executed by passing a thin-bladed knife straight through the joint while in a state of flexion. As soon as

this can be effected, the edge of the knife is turned forwards, and carried along the front surface of the bone to the extent of three-quarters of an inch, when the edge is again turned downwards, and cuts its way out. This is the most rapidly executed operation of the four, but is rather more difficult of performance in this manner than either of the others.

This operation may, however, be executed with far greater facility by making the flap before the cavity of the joint is opened. For this purpose the finger should be extended, and the blade of the knife introduced across the finger, close below the bones constituting the joint, and carried forwards to the extent of three-quarters of an inch in a large male hand, and then passed through the skin. The finger being now bent, the joint is opened behind, and the operation completed by a few movements of the knife. Ten seconds will suffice for this operation.

Fig. 56.

The third operation consists of an anterior and posterior flap. These flaps should each be formed before the joint is opened, and be made of sufficient size to meet in the centre of the head of the phalanx, and both should be made from the skin inwards, instead of cutting out, as in the last operation.

The same remarks apply to the operation with lateral flaps.

In removing the last phalanges of the fingers, the second plan of operation becomes imperative, from the proximity of the nail.

AMPUTATION AT THE HIP-JOINT.

This operation comprises perhaps the largest and the most dangerous effort made by the surgeon for the preservation of human life,

and among the most advanced steps in the onward march of human daring. Although amputation at the hip-joint is an operation of which the fatal result largely predominates over success, yet cases occur on the field of battle, and occasionally in hospital practice, in which the experiment is a justifiable, and almost a compulsory one on the part of the surgeon. The warrant for the resort to this frightful alternative is found in such disorganization or destruction of the limb, to within a few inches of the joint, as precludes the possibility of amputation below it.

In no other part of the human body in which amputation is performed, is it so indispensable that the necessities of the case be clearly established, for this is not a question of *mutilation*, but a question of *death*, and the life of the subject probably hangs on the decision of the surgeon. Two points of consideration should occupy his mind: first, the necessity of the operation; and, secondly, the mode of its performance, on which latter question, I conceive, the probability of failure or success will greatly turn. What are the necessities of the case? What extent of injury will justify the resort to it? Certainly, nothing short of such destruction of parts as will, in all professional and scientific probability, lead to the death of the individual without it. Severe compound fracture actually involving the head of the bone or the acetabulum. Comminuted fracture of the bone by a musket-ball, extending up to the joint, coupled with extensive injury to the muscles and integuments below it; large bony tumors, or incurable disease of the femur. It is, indeed, the last resource of the surgeon. Anatomical knowledge of the joint and its appurtenances is indispensable to a sound opinion, as it is equally indispensable to the proper performance of the operation by the surgeon. He should fix his attention on the situation and relations of the head of the bone, and all the salient processes around it; he should study the component structure of the material about to form the investing covering to the exposed pelvis. Possibly, on more careful inquiry, it may appear that amputation below the trochanter will answer every purpose, and an operation of less danger may be substituted.

In the winter of 1848, the body of a man was brought into the dissecting room of St. Bartholomew's Hospital, who had undergone amputation of the thigh by Mr. Lawrence, immediately below the head of the bone, in the early part of his professional career. The head of the bone was greatly reduced in size by atrophy. It would

have been an easy but very unnecessary addition to the operation to have removed it.

This operation is of French design, although first executed in England. But modern surgery has many resources short of the removal of the entire limb at the joint for diseases which, at an earlier date, were supposed to justify it; and it is rarely, except in cases of extreme injury from violence, that it can be justifiable. Whenever, then, we hear of the frequent resort to amputation at the hip-joint by any individual, we may ask, without suspicion of a wrong intention on his part, whether all the alternatives to such an operation were exhausted before the resort to it was made.

This operation, like that of all the larger joints, requires for its efficient performance not less than two operators, for the duty of the assistant is so important, and so indispensable, as to place his functions almost on a par with those of the principal. It is his duty not simply to hold the limb, but to employ its various movements of rotation, abduction, &c., to the end of determining the direction and the extent of the incisions. He has the power in his hands of usefully promoting, and equally of thwarting the designs of the principal, and an entire unanimity should prevail between them, the result of previous agreement. In all the varieties of the operation, the circulation through the external iliac artery is arrested by the pressure of the hand of an assistant against the os pubis.

The operation which has been commonly resorted to by surgeons, both civil and military, is that of the double flap. Success has attended them in the proportion of about one in four or five cases. This fatality is not explainde by reference alone to the formidable character of the injuries received, because it has been equally great in the deliberate amputations of the limb for chronic disease. It owes this fatality to its magnitude, to the enormous exposure of surface, coupled with loss of blood inevitable to the division of so many and so large vessels; for this loss, although not necessarily great compared to the bulk of the limb removed, is positively so when superadded to the shock on the nervous system, incidental to the separation of so large a portion of the frame from the remainder. The evil of this large exposure of surface can best be met by the circular division of the muscles, and I entirely concur in the opinion of many authorities of the highest eminence in this country, that under all permissible circumstances the flap operation should be entirely superseded by the circular one, so far as relates to the muscles, I mean,

whenever permissible by the condition of the structures around, and mutilation in most shapes will more generally militate against the flap than against the circular operation. The flap operation of the integuments with the circular division of the muscle, is, in my opinion, the most suitable operation for the hip-joint, insuring a sufficient amount of integument obtainable from any part of the circumference of the thigh, supposing partial mutilation to have occurred, exposing the smallest possible surface of the muscular system, while it guards against excessive hemorrhage by the transverse division of the large vessels that supply the limb. But it is impossible to lay down rules that shall not be subject to numerous exceptions. The most apparently suitable operation, when performed on the dead subject, may prove the least applicable in any given case. Any form of operation may become imperative for the occasion, the double flap in all its varieties of relation to the aspect of the limb, the circular, or the composite, or flap of the integuments.

The depth of the joint, and the complete muscular investment of the bone, will, at all times, attach some uncertainty to the extent of the injury sustained by the bone, supposing it fractured. The injured parts may, probably, be entirely got away by sawing the shaft of the bone below the trochanter minor, instead of removing the head from the socket, and it is a desirable proceeding, if practicable. *Cæteris paribus*, the removal of the shaft below the trochanter minor is preferable to excision of the head, but much consideration is due to the difficulty of effecting this separation, and to the time occupied in the undertaking, the difficulty of applying the saw without injury to the already divided parts, and which, if applied, must add something to the time already occupied in the operation. Larrey, Velpeau, and other authorities chiefly of the French school, are unfavorable to this attempt. I consider it a desirable end to achieve, if practicable; but it should be fully understood to require a previous design, because the flaps that would be suitable to amputation at the joint would be insufficient for this latter operation.

A few words on the anatomy of the articulation may be useful. The head of the femur revolves in the acetabulum immediately below Poupart's ligament, nearly at its centre. The position of the head is perceptible on pressure of the fingers during rotation of the limb, at a distance of less than an inch beneath the skin. From the head of the bone, the neck, an inch and a half in

length, extends downwards and outwards to the shaft, at an angle of 135°, or a right angle and half. The shaft is continued upwards in a straight direction, to the extent of above an inch, to form the trochanter major, covered on its outer surface by the integument only. The trochanter major extends upwards nearly to the level of the head. The trochanter minor lies behind the inner side of the neck, two inches lower down the thigh than the middle of a line drawn transversely from the trochanter major to the centre of the head. The salient points of the pelvis may be distinctly felt, viz., the anterior, superior, and inferior spines, the spine of the pubes, and tuberosity of the ischium. The joint is invested in front by the psoas and iliacus muscles. The fleshy mass on the inner side, extending to the mesial line of the body, is formed by the pectineus, three adductors, and gracilis, on the outer side by the three glutei, and behind by the flexors of the leg, semi-tendinosus, &c., and by numerous smaller muscles, applied closely on the back of the joint, performing the office of rotators outwards. The tuber ischii projects inferiorly nearly three inches lower down the limb than the spine of the pubes in front. The obturator or thyroid foramen, therefore, in the horizontal position of the body, looks upwards, and the knife of the operator of the double flap may enter it without difficulty. The head and neck are surrounded by a strong fibrous capsule, and the head is further connected to the cavity by the *ligamentum teres*, attached around the notch, extending to its base.

The femoral artery takes a straight direction downwards, over the inner third of the head of the bone, and at the point of its division by the knife, is placed about an inch to the inner side of the shaft of the bone.

M. Larrey tied the femoral artery before proceeding to amputate. This proceeding is justly objected to by all reflecting surgeons, among whom the name of Abernethy stands prominent.

Double Flap Operation, by Larrey.—As already stated, the femoral artery is first tied above the origin of the profunda. The patient is placed horizontally at the bottom of a bed or table of a convenient height. A long straight-pointed knife is plunged vertically through the thigh, close to the inside of the neck of the bone, and carried downwards along the bone, and then through the muscles and integuments, to the surface. This inner flap contains the femoral artery and vein. The flap being raised by an assistant,

the joint is to be exposed and opened, and the ligamentum teres cut asunder. The head being dislocated, the knife is again introduced along the outer edge of the acetabulum, and the second flap made by cutting downwards and outwards, between the trochanter major and the skin. This part of the operation will be much facilitated by the thigh being greatly abducted by the assistant, who at the same time forces the head and trochanter from the outer skin. The flaps should not be too large.

The same Operation by Lisfranc.—This dexterous operator introduces the knife, which is straight and narrow, about an inch below the anterior superior spine of the ilium, which, passing close to the head of the femur, reappears through the limb, a little below and on the outer side of the tuber ischii. He thus cuts the flap from the outer side, passing the knife around the trochanter, from which he separates the integuments. Then, grasping the mass of muscle on the inner side, he again introduces the knife in front, and passing it close to the neck of the bone, the handle sloping a little backwards towards the abdomen, to avoid the obturator foramen, he carries it through the limb to the point of termination of the first incision. He then divides along the bone to the extent of two inches or more, and cuts through the mass to the skin. If practicable, the fingers of an assistant should follow this incision as quickly as possible, to compress the femoral artery before it is divided. The joint is then opened on the inner side, the limb being abducted, and the remaining soft parts divided. The line of junction of these flaps will be oblique, from above downwards and inwards.

Mr. Guthrie's operation is, I conceive, a great improvement on both the methods above described, for reasons I have already stated, while on the subject of flap operations in general; viz. the difficulty of calculating with precision the necessary size of the flaps, when made by incision from within outwards. In order to obtain exactness of quantity in these flaps, great experience is required; and few men possess this experience, or, it is to be hoped for the cause of scientific surgery, are likely to obtain it.

It may be well to remind young operators, that in estimating the relative merit of an operation, that of rapidity of execution falls far short of the greater merit of safety; and the question of safety can only be determined by the more frequent recovery from one form than of that from another form of operation. To adopt an

operation merely because it is executed with eclat, is to sacrifice the interest of our patient to an ungenerous and very morbid love of notoriety. Delicacy of manipulation takes the lead of rapidity in actual merit. Rapidity in the performance of the flap operation, one of its greatest merits, requires a knife of peculiar make, which does not form a part of the material of every amputating case.

The size and form of a flap can be far better determined by an incision commencing in the skin and carried downwards, than by one made in the opposite direction, viz., by transfixing the limb; and hence the improvement of Mr. Guthrie's operation for amputation of the femur at the hip-joint, the result of great military experience on the field of battle. This operation consists of two flaps made through the skin, commencing four fingers' breadth, in a direct line, below the superior spine of the ilium; and continuing each round to a point below, and equally distant from the tuber ischii. The integuments having retracted, the muscles are divided obliquely upwards to the joint, which is opened, as in the former operations.

A pleasing variety of about eighteen operations for removal of the femur at the hip-joint have been practised; but I shall quote one more only, which appears less objectionable, looking to the result, although less brilliant in the execution than the double flap.

Mr. Abernethy's operation consisted in a circular incision of both integuments and muscles, made consecutively to each other, as in ordinary amputations. The circular flap of the integuments in this region does not form so good a stump as may be insured by a double flap of the integuments only; but the merit of this kind of operation consists, not in the division of the integuments, but in that of the muscles.

Operation by Flap of the Integuments and Circular Division of the Muscles.

The body of the patient, as in every form of this operation, should be placed horizontally, and be well and sufficiently drawn down to the bottom of the table, to free the limb in all its movements. The limb is to be consigned to the charge of an intelligent assistant, whose actions will respond to every indication of the principal. The femoral, or rather the external iliac artery, should be kept under firm pressure against the bone, by means of a *large* compress of lint,

placed over the artery, against which the end of the closed fist of a strong assistant should be pressed with considerable weight. The compress should be, at least, as large as the body of a lumbar vertebra, and if wetted, will be less liable to slip. The larger this compress and the more general and obtuse the pressure, the higher can it be applied on the artery. The weight of the body should be employed in compression, and not the muscular agents of the arm alone. There is no necessity for active pressure until the muscles are divided.

The dimensions of the limb should be measured. The circumference of a well-sized thigh is about twenty inches, and its diameter therefore about seven. The flaps from the centre of their arch to their base should therefore be full three inches and a half to four inches in length; but it should be recollected that they have no projecting central bone to invest, but rather that of a flat surface, and also that the circumference of the limb is not circular, but irregular in form, being flat in front and projecting farther from the centre in some parts than in others. The flaps, therefore, should not be made too arched, and no integument should be wasted at their angles or points of junction. Their proposed line should be marked in ink before the operation is begun. The instrument employed should be a common strong amputating knife of the largest size, turned up at the end, and sharp to the point. The first flap may be commenced about one inch below the anterior superior spine of the ilium, and carried straight down for about an inch and a half, and then inclined inwards, nearly following the line of Poupart's ligament and about four inches below it. Reaching the adductor longus muscle, descending from the os pubis, it should be carried round in a gentle curve to a point about two inches below the tuber ischii. The second or outer flap should cross the shaft of the femur immediately below the trochanter major, and run almost circularly backwards to the same point as the former. The flaps being reflected high, the muscles may be divided by a circular sweep, applied with great force of pressure, commencing with the adductors on the inner side, keeping the knife close to the bone both at *their* origin, and also on the division of the flexors of the leg arising from the tuber ischii. The circle should be completed in front, when the femoral artery will be divided, and should be immediately tied, if the pressure by the assistant fail to arrest the hemorrhage. In dividing the muscles, the limb should be made to follow the application of the knife to each

surface, abducted in division of the muscles of the inner side, elevated for the flexor behind, and adducted for the glutei. The capsule being bared should be divided in front, the head disarticulated, and the ligamentum teres cut asunder, during powerful abduction by the assistant, and the arteries tied *to the smallest size.* Besides the femoral artery, three or four vessels of magnitude will require ligatures, viz., the obturator, the ischiatic, and external and internal circumflex. The line of junction of the wound will be nearly vertical, or rather obliquely inwards. The flaps may be united by the compound agency of sutures, of which three or four may be employed, and of plaster, and over these a *large* compress of cotton wool should be applied, by means of a roller carried round the body. It would be well to leave the last inch of the wound open for the escape of secretions from the cavity, to be covered for the time by simple dressing.

This form of operation is less rapid, and therefore less striking than the double flap; but it has one great compensating merit, it is safer, and is in reality more brilliant, if such a term be ever admissible. The difficulty of disarticulating the head of the bone, after sawing through to the shaft, is much increased if the neck be broken. Indeed, it is almost impossible, under such circumstances, to apply the saw. In such cases we have no alternative but that of removing the entire bone at once.

AMPUTATION BELOW THE TROCHANTER MINOR.

In this operation the same proceeding in reference to the soft parts should be adopted as in the last operation, modified by the circumstance of an increased length of about two and a half inches. The same duty will devolve on the two principal assistants, one in compressing the artery underneath Poupart's ligament, and the other regulating the movements of the limb during the division of the muscles. The flaps being now required to meet at a projecting centre, formed by the bone, should be made a little more conical. The muscles being completely divided, a linen retractor will be required, and should be applied deliberately and carefully over the muscles. The division of the femoral artery will be made *below* the origin of the profunda, which will require at least one, and possibly more additional ligatures in this part of the stump.

AMPUTATION OF THE THIGH.

It is desirable, in amputating the thigh, to save as large a portion of the limb as possible. Every additional inch of bone is valuable. But it is not only in relation to the utility of the limb hereafter that this law is imperative, but it owes its existence to the fact that every additional inch of bone removed above the knee increases the danger of a fatal termination. Almost as critical a question as that of amputation above or below knee, is that which applies to the part of the thigh selected for division. The evidence of recovery from amputation above and below knee is so conclusive in favor of the latter expedient, that it should always be resorted to, if practicable; while, with regard to the thigh, we have the additional motive which applies to the future utility of the limb. To understand this principle, we have but to observe the different gait of a person whose thigh has been amputated immediately above the knee, and who has retained at least three-fourths of the bone, from that of another in whom amputation has been performed at the middle or junction of the upper with the middle third. We cannot but be struck with the easy natural movements of the one, when contrasted with the lateral writhings and contorted efforts at progression employed by the other. It has been deemed sufficient for the purpose of carrying the thigh forwards in the act of stepping, that the psoas and iliacus muscles, as the agents of extending the limb forwards, should be alone retained; but this general opinion is an erroneous one, *these* muscles not being even concerned in that movement. The act of flexion of the thigh is effected solely by the rectus femoris, of which as large a portion as possible should be preserved to continue its former function. The division of the muscle does not preclude the retention of its office. It acquires a sufficient adhesion to the material of the stump to answer every useful purpose, as an agent of flexion of the thigh on the pelvis, although that of extension of the leg be destroyed. In the act of walking, the thigh-bone forms the radius of a circle, and the longer the radius, the longer the step taken in progression, the more equal the movements of the two limbs; and finally, the longer the portion of the thigh retained, the greater the facilities of applying the material for artificial support. It is very true that it is of no moment whether the radius consists of a living thigh and leg, or of dead

wood or other material; but it is of every import that the rectus muscle, which is the sole agent by which the leg is put forwards in stepping, in what is called flexion of the thigh, should be retained of as great length as possible, that its action may be free, and sufficient to the required purpose. It is surprising that a surgeon of the eminence of the late Mr. Liston should have counselled the necessity of not sawing the bone below its middle, "because a long stump is inconvenient to a person in any walk of life."

The thigh is, perhaps, more frequently amputated for disease of the knee-joint than from any other cause; and it should be removed immediately above the joint. Either of the three operations may be adopted. The bone is well invested by muscle in its whole extent, and the opposite flaps, be they transverse or vertical, will sufficiently well correspond in size and form with each other. Experience appears rather to favor the transverse, in preference to the vertical flap, the description of which I give in the words of the late Mr. Liston:—

"The surgeon places himself on the tibial side of the right limb, the fibular side of the left," (on the left side of either leg;) "he lays hold of the soft parts on the anterior aspect of the bone, lifts them from it, enters the point of his knife behind the vena saphena in operating on the right side, passes it horizontally through to the bone, carries it closely over its fore part, and brings out the point on the outward side of the limb, as low as possible; then, by a gentle and quick motion of the blade, a round anterior flap is completed. The instrument is again entered on the inner side, passed behind the bone, brought out at the wound on the outside, and directed so as to make a posterior flap in the direction of the dotted line, a very little longer than the former."

I have quoted the above passage simply to show how insufficient are these directions for the formation of a good, serviceable stump, and referring to "the dotted line," in the plate annexed, the reader will observe that more than one-third of the length of the thigh is involved in this posterior flap, which ought to equal the semi-diameter of the limb only. It is in no captious spirit of criticism that I make this comment, but simply for the purpose of exhibiting the substantial defects to which a really good operation may be liable. Such flaps as are above described would form to the eye a capital, well-rounded, and smooth stump, and if that were all that is required, no objection could be raised to this kind of operation; but it

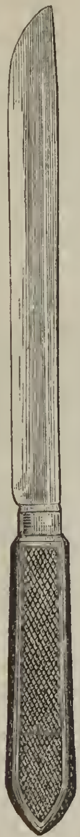
must be apparent that the chief substance of this stump is muscle, and that the two opposite surfaces are far more largely involved about the end of the bone than is desirable, considering that the weight of the entire body has to be supported upon it hereafter. As I have before remarked, the evil of amputating, by transfixing the limb by double flap, consists in the excess of soft material left, and that of the wrong kind. If the quantity and size of the flap be sufficient, and not more than sufficient, this operation loses much of its objections, but in this lies the difficulty.

In the double flap, formed by transfixion, careful measurement of the limb should be previously made, and equally careful observation of its condition, whether of firmness or of relaxation. No two structures can more largely differ than that of the thigh, which is usually firm, hard, and tight, as observed in a healthy condition of the system when amputation is required for compound fracture, and that of softness, relaxation, and tenuity, caused by the wasting of the muscles, which it exhibits after protracted disease. In the former condition of health, I conceive the circular amputation of the muscles to be most suitable to the formation of a good and efficient stump, while for the latter, the double flap is more appropriate. Whether the circular amputation of the muscles be preceded by the circular division, or by a double flap of the integument, is a question of less importance, but, as a general rule, I prefer the latter, which seems to combine, in a great measure, the advantages both of the circular and flap operation by transfixion. In transfixing the limb, whether by transverse or by vertical incision, sufficient material should be left to cover the bones, and to meet easily and without tension; more than this is an evil to be avoided, for reasons already given. In a healthy limb of eighteen or nineteen inches in circumference, the flaps should not greatly exceed its semi-diameter, and the knife should be brought out, allowing for the retraction of the soft parts when divided, at about four inches from the base of the arch, along the line at which it was introduced. The soft parts should be drawn up by means of a linen retractor, and the bone sawn as high as possible, especially when the muscles are large.

In the performance of this operation, the great inequality to which the upper and lower flaps will be liable may be prevented by giving support to the back of the thigh by the hand of an assistant, during the first introduction of the knife, and the formation of the anterior flap. Under any circumstances of direction, whether by vertical or

transverse flap, it is desirable to give such support to the soft structures as to place the bone as much as possible in the centre of the limb, and to give equality to the opposing flaps.

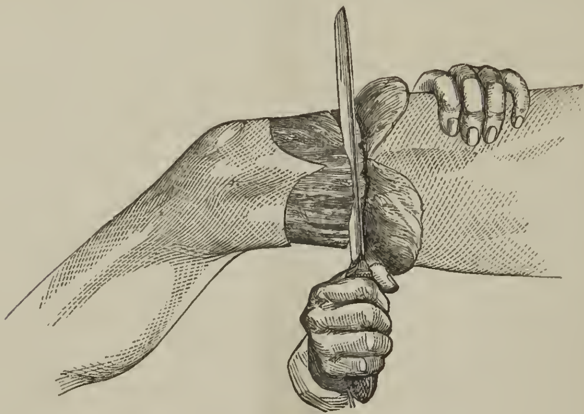
Fig. 57.



The flap operation should be performed with a long, pointed but narrow knife, double-edged at the point only. The circular operation requires a common amputating knife of the largest size, straight in the blade, with its cutting edge turned up to the point, and also slightly at the handle, if the breadth of the blade exceed that of the handle, in order that the extremities of the instrument may be applied to the surface on the principle of the saw, and not of the wedge. Of these operations I prefer the double flap of the integuments, and the circular division of the muscles. The breadth of the limb should

be calculated, allowance being made for the elastic recoil of the integuments when divided. The flap should be sufficient, and not more than sufficient, to meet without effort. They should correspond in size, and not be made too arched. In dividing the muscles, the knife, unless the thigh be of unusual dimensions, should be carried down to the bone at once, and this can only be effected by the application of considerable force, great care being taken that the muscular mass behind the bone be not pushed before the knife, but divided without displacement from its natural relations to the parts

Fig. 58.



around. When the thigh is very large, it would be well if the looser muscles, such as the rectus sartorius in front, the biceps, semi-tendinosus, and semi-membranosus behind, were divided separately, and allowed to retract, before the division of the remaining muscles which are attached to the bone. But this proceeding is not very easy of execution, nor would it be possible to effect it without considerable loss of time; and although it might improve the form of the stump to the eye, I doubt whether by its means a better support could be given to the weight of the body when thrown upon it; all the arteries should be carefully secured, and more particularly so in the flap operation, where secondary bleeding requires the entire material of the stump to be displaced, for the purpose of discovering the bleeding vessel. In either operation sutures are advisable, and are imperative in the double flap, and especially so if the flaps be left of unnecessary length. The remaining part of the opposite surfaces should be carefully adjusted by means of good plaster, and sufficient pressure be

made, when the stump is flabby, to insure the absence of a cavity within. To prevent the consequent pain, on dressing the limb, from this too frequent cause of suffering, it would be well to have the male thigh shaved before amputation. The patient should be placed on his back, and the stump slightly raised on a pillow.

One other operation is worthy of mention, which consists in the division of all the textures of the thigh by one single circular incision made down to the bone. It is an old operation revived by Dupuytren, and is applicable to the upper arm or thigh, when greatly reduced by disease. Under these circumstances sufficient integument will be left to invest the muscles and the bone, provided the assistant draw the integument up with some force before the incision be made. The bone should be sawn as high as possible.

The operation of amputation at the knee-joint is a relic of ancient surgery, and is very properly discarded in modern times, as answering no good purpose, tantamount to its danger.

ON AMPUTATION OF THE LEG.

Before proceeding to amputate the leg, it behoves the surgeon to ascertain the position of life of his patient, his occupation, and means of resorting to such form of artificial support as mechanical ingenuity has devised, as a substitute for the extremity removed. This substitute may consist in the ordinary wooden leg, or in an artificial imitation of the former foot. For either of such kinds of support, the stump and length of the limb must be previously rendered suitable. If it be intended that an artificial foot be used, the leg should be amputated as low as possible, and the removal of the diseased or injured part only is all that is justifiable; while, on the other hand, such a length of leg would be very unsuitable, and really inconvenient to a person whose means in after life could provide no substitute but that of the common wooden leg. In the latter case, we amputate from four to five inches below the knee-joint, being content to retain just so much of the tibia as will rest, in flexion of the knee, in a direct line with the condyles of the femur, on a cushion of soft material; beyond this the projecting leg is an evil, being exceedingly inconvenient on account of its length, a useless appendage to the rest of the body, and holding a kind of sinecure on the general system, retaining all its organization, and

claiming its support, but contributing nothing to the common weal by its labor or exertion.

By amputating at this distance below the knee-joint, we retain all the agents of flexion and extension of the joint; but all are not equally serviceable, whatever a superficial glance at their respective functions might determine. In front of the knee we have the rectus, no longer useful as an agent of extension of the leg on the thigh, restricted to the act of extending the limb forwards in progression; whereas, the remaining agents of extension of the leg, viz., the cruræus and vasti, have no office assigned to them, in consequence of the permanent flexion of the knee; on the other hand, the flexors of the leg are paralyzed from the same cause; and even the secondary action of the biceps, semi-tendinosus and semi-membranosus—that of supporting the trunk in the attitude of stooping—is rendered almost nugatory by the substitution of a small rounded pillar for the extended foot. Although the action of a muscle may refer proximately to the movements of the joint below which it obtains its insertion, its remote action may be subservient to distant parts. The condition of all these muscles in the neighborhood of the knee-joint is changed in cases of amputation above the ankle, where an artificial foot supplies the place of that removed; or, in other words, they retain their original functions, the majority of them in power, if not in number, influencing the movements of the thigh on the pelvis, in addition to that of the leg on the thigh.

On Amputation in the middle of the Calf of the Leg.

No part of the body exhibits so great a disproportion between the muscular substance of its opposite sides as this; and, consequently, no ordinary operation will include all the requisitions of a perfectly formed stump. Of the two bones, the larger, or tibia, occupies the anterior aspect of the limb, and is covered on one of its largest surfaces by skin only, along its whole extent, while the fibula is tolerably well invested by the muscles arising from it. In the circular operation, sufficient integument can be obtained to cover both the bones and the great muscle of the calf. But, should the calf of the leg be large, a huge fleshy mass is left by the divided muscles behind the bone, extremely unsightly, and not very readily healed, by reason of the dragging of the pendulous muscles, which are only partially connected to the bone in front. This, however, is

the greatest, though not the only evil of this operation, and should not be urged beyond the bounds of a moderate objection, inasmuch as the end of the stump, when amputation takes place high up in the limb, will probably not be required for support, as in the case of the thigh; and, secondly, that nature will round the stump eventually by the absorption of the useless muscles behind. The objections to the circular amputation of the leg at the calf are, therefore, not very great.

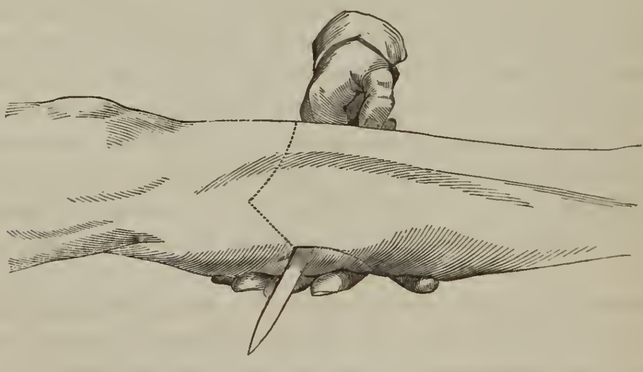
Circular Amputation.—The tourniquet may be applied on the femoral artery, half way down the thigh, care being taken to compress the vessel towards the centre of the limb against the bone; or it may be applied on the popliteal artery, the screw of the tourniquet being fixed over the patella. In either case, about an inch in thickness of the coil of a roller, softened by a few blows of the heel on the ground, or a roll of lint, should be interposed between the pad of the instrument and the skin over the vessel. Supposing the circumference of the limb to be twelve inches, the first incision through the integuments should be reflected back to the extent of about two inches and a half, and rather higher over the projecting bone than over the retracting muscles behind it. The operator, standing on the right side of the limb, now endeavors to divide all the projecting muscles by the circular sweep of the knife. But in this act some tact is requisite, lest the loose gastrocnemius muscle, being unconnected with the bone, be pushed before the knife, and divided obliquely. A fine catlin introduced between the bones will complete this division of the muscles. A linen retractor, triple tongued, should be employed to protect the muscles from the saw, and to expose the bone as high as possible; and the bones should be sawn together, by adapting the edge of the saw to both at the same time. The front edge or spine of the tibia may be afterwards removed to the extent of half an inch. The direction of the cicatrix, whether transverse, vertical, or oblique, may wait on the option of the operator, and be determined by the convenience of dressing, or by the liability of the tibia to exposure by after retraction of the flap.

Double Flap Amputation at the Calf.—The operator stands on the right side. A small anterior flap of integument only is made in front of the tibia, extending outwards as far as the fibula, and should be reflected. A long, pointed, narrow knife, double edged at the point, is then introduced along the posterior surfaces of the two

bones, and brought out on the opposite side of the limb. This posterior flap is then cut downwards from the bones to a sufficient extent to cover the end of the stump. But, as the mass is thick, and will require a good deal of integument to cover it, this flap is usually made very long. I have seen it often of six inches in length. The division of the soft parts is completed by the catlin. These edges are then adapted. This is a very objectionable operation, obeying none of the requirements which are imperative in flap operations elsewhere. The bone lies at the side and not in the centre, the anterior flap is exceedingly thin, the posterior flap exceedingly thick and disproportionate in size, and this fleshy mass is brought entirely over the ends of the bones, and there is no correspondence between the flaps when attempted to be brought into apposition. The thickness of the calf renders it unwieldy and inflexible, and projecting at the angles in an unsightly manner, it has all the appearance of a displacement of the calf. The objection to this operation lies in the mass of substance carried forwards, and this may be avoided by a better operation, which I have for many years adopted, and which appears to me an improvement on the former.

Amputation at the Calf by transfixion of the Calf in part only.—The operator stands on the right side of the patient. The leg being raised, the calf is supported on the open palm of the left hand of the operator, by which it is flattened out considerably in breadth. The knife is then introduced through the skin at a depth of not more

Fig. 59.



than half or three-quarters of an inch above the palm of the hand, and passed straight across to the opposite side, and the posterior

flap, which in addition to the integuments will thus include a small thin portion of the gastrocnemius, is formed of sufficient length to pass forwards around the end of the tibia. The anterior flap is now cut, but of small dimensions. A circular sweep of the knife around the limb is then made, which divides the rest of the calf, and the catlin is introduced through the deep muscles and interosseous membrane. By this means a posterior flap is formed, which being thin corresponds with that in front, in size and substance, and leaves little or no muscle for after absorption. When the entire calf is brought round the bone, I have known upwards of three months required for the healing process, and in such operations, when the calf is large, the aspect of the stump is almost ridiculous.

In amputating the leg immediately below the knee, it is very desirable to avoid the division of the ligamentum patellæ, if possible; not with the idea that the muscles inserted into the patella will thereby lose their function as agents of extension of the leg, but because the action of one of them, viz., the rectus, will be compromised as an agent of flexion of the thigh: and certainly, if the tibia be divided as high as the tuberosity, too small a portion of the bone will be left for convenience in kneeling on the cushion of the artificial support.

These operations are performed on the same principle as that last described, taking a small thickness only of the gastrocnemius, in addition to the skin, to form the posterior flap, supposing the flap operation to be selected; but the circular operation is not unsuitable to this region, because the muscles behind are thinner, and the bone projects more considerably towards the back part of the limb.

There can be no necessity to remove the head of the fibula, nor any advantage from this unnecessary addition to the operation, but not on account of the reasons usually assigned by authors, viz., that the articulating surface communicates with the synovial membrane of the knee-joint, which it assuredly does not do, except in very rare examples of structure; of the flexors of the leg, the semi-membranosus alone will escape division in amputation as high as the tuberosity of the tibia.

Amputation of the Leg between one and four inches above the Ankle-joint.—This operation is necessary when the entire bones of the tarsus are so far injured or diseased as to render the removal of the foot compulsory. The advantage obtained from selecting this situation is that of its convenience for the application of an arti-

ficial foot, or some permanent support, as a substitute for the foot. It is therefore, for the most part, unsuitable to the necessities of hospital patients. Ten muscles will require division, the larger number of which are reduced to tendon; the stump will necessarily, therefore, be integumental.

The tourniquet may be applied in the ham, with the addition of a compress of linen placed underneath the pad of the instrument. The double flap operation by transfixion is unsuitable to the structures to be divided. The division of the tendons can never be cleanly and well effected by the flap operation. They require a transverse section while supported behind. The best operation is that of the double flap of the integuments. These should be made in front and behind, and ample, though not excessive in length. Supposing the leg to be nine inches in circumference, each flap will be required of the length of about two inches, allowing for the retraction of the integuments. The flaps should not be too much arched, but so made as to meet along a nearly straight line. The centre of each lateral aspect of the leg may form the extremities of each arch. The muscles and tendons being divided, the catlin should be used with some care, and the incision effected by it be smooth, and not jagged. A triple-tongued linen retractor should be employed, and the bones sawn together. The three arteries of the leg may require ligatures. Of these the peroneal will be found running along the inner side of the fibula.

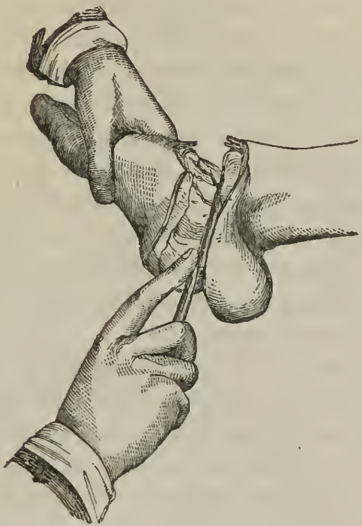
AMPUTATION OF THE FOOT AT THE ANKLE-JOINT.

The great importance of retaining as much of the lower extremity as possible has led to a very good operation, which was first adopted by Mr. Syme, of Edinburgh, viz., amputation at the ankle-joint, for the removal of the foot. The tourniquet may be applied in the ham. This operation is thus performed.

An imaginary line is drawn round the sole of the foot from each ankle, and this constitutes the line of the first incision, which is to be carried down to the bone, throughout its entire length. The foot is now raised, and held firmly by one, or even two assistants, or supported off the level of the table or bed by a firm pillow, placed at a little distance above the ankle-joint. The operator then proceeds to reflect the integuments with the subjacent fat from off the os calcis, until it is completely separated from the bone, and pushed

loosely backwards, exposing about an inch of the tendo-Achillis, which tendon may be at once divided. The upper angles of the first incision are then connected by a nearly transverse line across the

Fig. 60.



front of the joint, which should penetrate the cavity. The lateral ligaments may then be divided, the foot dislocated from its socket in the tibia, and the remaining tendons divided. The flap is then drawn forwards over the ends of the tibia and fibula, and united by suture and plaster. The stump will require the pressure of cotton wool, in consequence of the rapidity of the flap adapting itself somewhat imperfectly to the cavity in the end of the tibia.

Amputations between the Bones of the Tarsus.—It is the duty of the surgeon to retain as much of the foot as possible, in all diseases involving a part only of its structure. As these are among the most difficult of the amputations, it is very necessary that the bony structure of the foot be carefully studied before proceeding to amputate, and the best evidence obtained in determining the extent of the disease or injury it may have sustained. No artificial support can compare with the advantage derived from the retention of the os calcis and astragalus, for example; and if to these we have the power to retain the navicular and cuboid bone, the merit of the operation is yet more complete.

Amputation across the middle of the Tarsus, or Chopart's Opera-

tion.—By this operation, the astragalus and os calcis of the tarsal bones are alone retained. The articulation between these bones and the navicular and cuboid is opened nearly directly across the foot. But this portion of the foot gives a firm support to the body in progression, and it is greatly preferable to any artificial agent, although forming little more than a mere pillar; for, though the movements of the ankle-joint remain unimpaired, yet the actions of all the muscles of the foot are destroyed. Indeed, those of the calf of the leg are the sole remaining agents which retain their insertion; yet their function is destroyed by the removal of the foot, their office being that of raising the weight of the body upon the distal extremity of the metatarsal bones; but as these bones are removed, the function of the muscles is lost, and the muscles of the calf must always be absorbed in cases in which the above amputation has been practised.

Chopart's operation on the foot is required in disease or injury of the metatarsus, probably involving the five smaller tarsal bones. In examining the articulated foot, it is apparent that these bones, viz., the navicular and cuboid, are connected to the astragalus and os calcis along a nearly straight line. This line may be determined with some precision by the following rule. About half way along the outer edge of the foot, the fifth metatarsal bone will be distinctly felt to project. In a line backwards from the proximal surface of this rounded projection, measure three-quarters of an inch, and mark the point with ink. This distance of three-quarters of an inch corresponds with the outer edge of the cuboid bone; and from this point draw a line inwards of one inch in length across the foot. This line will correspond with that of the articulation between the os calcis and cuboid bone. To discover the articulation of the navicular bone with the astragalus, pass the thumb with some force of pressure over the inner side of the foot, an inch and a half in front and below the internal malleolus. The projecting bone then felt is the naviculare. This process gives insertion, below it, to the tibialis posticus, but its articulating surface, with the astragalus, is half an inch posterior. One inch, therefore, obliquely downwards, from the anterior surface of the malleolus towards this projecting process of the navicular bone, will correspond with the joint. This point should be marked in ink, and from it a gently curved line should be drawn, arched forwards, to meet that already made. This line will mark that of the articulation between the astragalus and navicular bones.

A small flap is made from above; the larger one from below. From the upper surface, the flap is formed by cutting about half an inch longitudinally, quite on the side of the foot, and then carrying the incision nearly transversely across the dorsum, but slightly arched.

Fig. 61.

This incision should pass down to the bones, and the flap be reflected. In making the lower or plantar flap, it should be kept in mind that the foot is considerably thicker on the inner than on the outer side, and consequently that this flap must be formed obliquely. The necessary apposition of the surfaces renders the formation of this flap by cutting from within outwards, after opening the joint, exceedingly difficult, the flap thus made being mis-shaped and unnecessarily thick. It is, therefore, advisable to make it below, commencing from the end of the first longitudinal incision (suppose on the outer side), and carrying it across in an oblique direction, forming a flap of nearly two inches in depth, until it reaches the articulation of the metatarsal bone of the great toe. It should then be carried backwards in a continued curve to meet the other extremity of the first flap. It is not desirable, in this lower flap, to dissect back the entire substance of the sole; but, as in the case of amputation of

the calf of the leg and elsewhere, to take a part of the thickness only, and especially at the beginning of the flap, increasing its thickness as it is reflected. The joint should then be opened from above, employing some force of depression of the foot with the left hand; *but not using force of pressure with the knife;* for the joint, which is close at hand, should be opened by tact, and not by force; and if the knife be applied to the right surface, it will pass without effort into the articulation; if in the wrong direction, no force will effect it. By such attempts to bring the operation to a close, it is generally prolonged considerably. The remaining soft parts being divided, the flaps are brought over the bones. Two or more arteries may require a ligature.

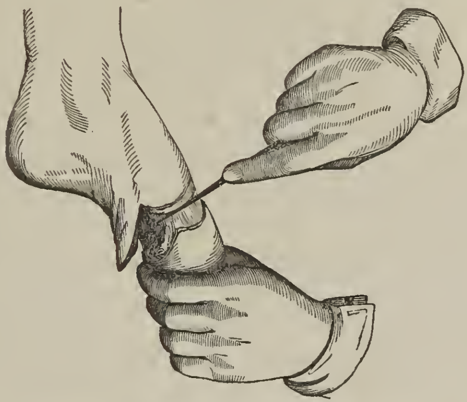
AMPUTATION AT THE TARSO-METATARSAL ARTICULATION.—HEY'S OPERATION.

This operation was first practised by Mr. Hey, and subsequently recommended and adopted by Lisfranc. It consists in the removal of the five metatarsal bones from the tarsus. This line should be thoroughly studied by the operator on the articulated foot, before proceeding to operate. Its general direction may be ascertained with sufficient accuracy in the following manner. The projection of the fifth metatarsal bone is always distinct. At its connection with the cuboid, this line commences on the outside, suppose of the right foot. On the inner side, the projection of the navicular bone is almost equally distinct on pressure. Press the last joint of the thumb vertically on this process, and the breadth of the thumb will correspond with that of the bone; measure one inch exactly in an ordinary sized foot lower down, and we have the line of articulation between the first metatarsal and the internal cuneiform bone. Unite these points by an arched line passing across the dorsum, corresponding with the natural arch of the foot, thus,  making the centre of the arch correspond with the second, and not the middle, metacarpal bone. This imperfectly formed arch would be complete but for the second metatarsal bone, which projects backwards, beyond the line of the rest, to the extent of a third of an inch, interrupting the continuity of the line across the foot, and articulating not only with its own cuneiform, but with the external and internal cuneiform and third metatarsal bones.

An incision should be commenced on the outside of the foot on

the fifth metatarsal bone, carried a little way down longitudinally, and then across the foot; half an inch below the line of the articulation, the distance increasing a little towards the great toe, and terminating well on the inner side of the foot. This slightly convex

Fig. 62.



flap being reflected, the under, or plantar flap should be made by an oblique incision, extending two-thirds along the metatarsal bones, and then carried back obliquely across that of the great toe, to join the inner extremity of the first flap. Part of the muscular substance of the sole only should be reflected towards the margin of the flap, but more towards the base. The joint being opened above, we come to the obstruction of the second metatarsal bone, which should be divided by a pair of bone forceps, and not attempted to be disarticulated. Except in very experienced hands, this is a very tedious undertaking. One or two ligatures may be required, and the flaps united by suture and plaster.

In the last two examples, the double flap operation recommended is, I think, preferable to the single flap. The line of junction may be made across the middle of the stump, or, as above given, somewhat higher; but pains ought to be taken to ensure some correspondence in the thickness as well as in the form of each flap.

If the material of either flap be imperfect, consequent on disease or injury involving the skin, sufficient integument may be obtained for a single flap either above or below. In reflecting the flap from above, I see no advantage in including the extensor tendons or the extensor brevis muscle.

AMPUTATION OF THE GREAT TOE, WITH ITS METATARSAL BONE, AT ITS TARSAL ARTICULATION.

This ought to be an operation rarely performed, for the value of the proximal extremity of this bone is valuable, as forming the insertion of the peroneus longus muscle. As a general rule, therefore, it is very preferable to divide the metatarsal bone by the saw or by bone forceps, instead of disarticulating it. The line of the articulation may be ascertained by the rule given in the last operation. The vertical measurement, or the thickness, of the tarsal end of the metatarsal bone, in a foot of ordinary dimensions, is one inch and an eighth, and the surface of the cuneiform bone requires, therefore, a flap of ample size. When required to be removed at the articulation, make the measurement, and mark the line of division by means of a loop of cord or string. This loop should be formed of seven inches in length of cord, and passed over the great toe, the end of the cord being drawn tight along the inner side of the foot, just below the inner ankle. Ink this line, and commence by placing the foot firmly on the heel, and inclined forwards in extension. With a strong but narrow scalpel, and at the same time holding the toe firmly, and drawing it from the rest of the foot, cut down along the dorsal line, over the metatarsal bone, to its inner side, continuing the incision for nearly an inch beyond the articulation about to be opened. Make a similar incision below, in both cases cutting cleanly upon the bone. Reflect the flaps backwards, and open the articulation, and remove the remaining soft parts. The two opposite edges of the flaps will perfectly correspond.

If, having exposed the metatarsal bone, it be not found indispensable to disarticulate it, the application of bone forceps, or chain, or metatarsal saw, half an inch only lower down the bone, will save the peroneus longus.

FOR THE REMOVAL OF THE LITTLE TOE WITH ITS METATARSAL BONE.

A loop of similar dimensions will be required, but the loop should be drawn downwards, quite along the outer side of the foot. The operation is performed by the same method as that adopted in the last case.

AMPUTATION OF THE GREAT TOE.

The articulation of the great toe, with its metatarsal bone, forms also a very large joint. The size is rather due to the metatarsal and sesamoid bones than to the phalanx, and the consequence is, that sufficient integument is not invariably left to cover it, when the operation is performed without rule or without sufficient consideration. If four inches and a half of string be formed into a loop and drawn over the great toe, it will form a very obtuse oval approaching to a circle around the toe. But this line of incision is necessary to insure the retention of sufficient integument to invest the distal end of the large metatarsal bone it has to cover, the size of which is yet increased by the presence of the sesamoid bones, which, supposing ample integument to be left, need not be disturbed from their position. This nearly circular incision should be made firmly, that the tendons may be at once divided. It is of no importance in what aspect it is commenced. The bone being cleared all around of its soft parts, the joint is opened, and the phalanges removed.

A second mode of effecting this separation of the great toe is by a double flap. Bend the toe downwards, and make a dorsal flap, which is carried round across the middle of the phalanx, from the integumental fold, between that and the second toe, to the side of the ball of the first toe, and reflect it. A similar line below, uniting the ends of the first flap by a circular sweep of the knife, forms the lower flap. The bone is then disarticulated, and the lower flap completed by cutting out. A third mode of performing this amputation, which insures sufficient integument, consists in making a straight longitudinal incision along the inner side of the toe, commencing about half an inch behind the articulation, and carrying it onwards to the middle of the first phalanx. At this end of the line make a circular incision around the toe down to the bone, reflect back the integuments and soft parts from it, and open the joint from above. These operations on the toe often require a ligature or even two.

AMPUTATION OF THE PENIS.

In this amputation, we endeavor to avoid excess of integument, by drawing it downwards at the moment of division. The organ is to be elongated by the left hand of the operator, and cut through by one sweep of the knife passing obliquely from behind forwards, for the purpose of leaving the urethra and spongy body somewhat longer than the rest of the organ. This is done with a view to keep the orifice of the urethra clear of the cicatrix. Two ligatures may be required.

CHAPTER X.

EXCISIONS OR RESECTIONS.

APPLICATION OF THE TERM.—A SUBSTITUTE FOR AMPUTATION.—OVERLAPPING OF BONE IN FRACTURE.—NECROSIS OF BONE.—UNUNITED FRACTURE.—OFTEN UNSUCCESSFUL.—LESS APPLICABLE TO THE LOWER THAN THE UPPER EXTREMITIES.—SPECIAL EXCISIONS.—LOWER AND UPPER JAW.—EXCISION OR RESECTION OF VARIOUS JOINTS.

The last quarter of a century has been a fruitful period in the performance of these operations, and the records of surgery in Britain and elsewhere teem with abundant evidence of the practicability of this valuable step in the onward march of judicious operative surgery. By the term resection, is understood the removal by excision of any portion of dead or diseased bone, whether composing a part of a joint or of the shaft. It is often practised for the removal of a joint of which the bony structure is the seat of disease. Thus it becomes a grand substitute for amputation in diseases of joints, and as such may be often classed among the most efficient operations in surgery, for the destruction of the joint, whether shoulder, or elbow, or wrist, is yet compatible with a good deal of useful movement of the limb, such is the conservative power of nature. But the success that has attended it, and that has interposed itself between the disease and the amputating knife, presents no small temptation to its performance in cases in which the resources of curative surgery are yet unexhausted; and I therefore recur to a remark I have previously made in reference to the subject of amputations in general, that diseases that are curable, and are cured in one hospital, are removed in another; and consequently we are not justified in resorting even to the lesser expedient of the excision of a joint, or a part of it, until every remedial agent of cure has been tried without success. The knowledge both of these agents and of the order and degree of their influence constitutes a distinct branch of surgery from that which forms the subject of this volume. A surgeon who has exhibited

the highest competency to the performance of difficult and rare operations, may be less competent than another to wield the curative agents referred to; and looking to the aggregate of medical men, it will be readily allowed that pre-eminent merit in both departments of surgical practice is, on the whole, more exceptional than common. If the excision of a joint redeem a limb from amputation, it does not sanction the resort to the knife, by the smallest relaxation of the imperative rules that can alone justify the resort to the larger operation, when that operation becomes necessary. The same incurability of a joint, and all the same conditions that justify amputation, must be thrown into the scale, to warrant the lesser operation of resection. If the disease be incurable, one of two operations must be resorted to, and of these two, resection presents less of objection than amputation, and therefore we have recourse to it.

It must be acknowledged in all candor, that the results of these operations for excision of joints, whether in part or entire, do not justify a very sanguine expectation. So far as the important end is achieved of the removal of disease, and the re-establishment of health, it is undeniable that much benefit may accrue to the subjects of the operation; but I think we should be careful how we hold out promises of recovery, or pledge ourselves to regenerate locomotive power, in the cases of operations for resection of the joints of the lower extremity. The functions of the upper and lower extremity are so widely different that an operation which may afford considerable benefit in the one case may terminate most unsatisfactorily in the other. I have seen more than one example in which the operation of resection of the lower limb has added little to the ultimate comfort or convenience of the affected person.

The operation which bears this name is not confined, however, to the excision of joints, but applies on a minor scale to many occasions, such as the removal by the saw or forceps of the overlapping ends of bones, in recent or in old fractures, in cases, also, of ununited fracture, or to the removal of either maxillary bone.

When in cases of fracture of the long bones, the attempt at reduction by elongating the limb fails to restore the bone to its natural relations, when the overlapping is considerable, and the projecting end of the bone great, promising positive abridgment of the length of the limb, if the bone protrude towards the skin, by which it is chiefly covered, as on the inner side of the tibia, for example, or the fibula; if the movements of the forearm be impaired by fracture of

either bone, on the same conditions, it may be desirable to cut down on the projecting bone and remove it. For this purpose an incision, sufficiently short in length, should be made upon the bone, which is further freed by the knife in dissecting around it; the limb is then bent at the fracture, so far as to protrude the bone through the wound. The soft parts being well protected by a thin plate of any metal at hand, by a copper spatula, or the blade of an amputating knife, the protruding bone is removed by the saw, or by the bone forceps, and the parts restored, the outer wound being carefully brought into exact apposition. It is hardly necessary to say that it is undesirable to cut deeply into the muscular structure of the limb.

A similar operation is occasionally required for the purpose of removing the ends of the bone in ununited fracture. It occasionally happens, after fracture, that the usual period expires without the least union of the broken bone; and weeks or months may elapse, often under the best management, without any attempt at reparation being made by the bone. But this result may originate in two causes, essentially distinct in their nature from each other. The one is dependent on local, the other on constitutional causes. In the one case, the difficulty has arisen, either in part or entirely, from the want of careful apposition of the broken ends, or from the want of perfect rest; in the other from deficiency of ossific action. In the first example, the shaft of the bone retains its natural thickness up to the broken extremity, where more or less callus is deposited; whereas, in the case of want of adhesive action, the bone is attenuated up to the broken part, and there is a total want of callus deposit, provisional or permanent. This distinction can generally be ascertained before operating, by the pressure of the fingers on the fractured part. Many means have been resorted to by surgeons to regenerate this want of action, by cutting down to the fracture and filing the ends of the bone, or sawing them off; or without the employment of the knife, to rub them with force against each other, or to pass a seton thread across the interval of the ununited bone.

Whatever operation be resorted to, it is desirable to select that aspect of the bone that is most accessible, and will less injuriously involve parts beneath, that are essential to the structure of the limb. The humerus should be exposed on the outer edge of the triceps muscle; the radius or ulna on their posterior and lateral surface; the femur on the outer side of the thigh, by cutting through the

vastus externus anterior to its origin from the linea aspera; the tibia, on its inner side.

An incision of sufficient length being made down to the bone, each extremity of the fractured bone is alternately brought to the outer wound, and a chain or fine saw applied; removing from a quarter to half an inch, or even more, where it is evident that absorption of the bone has taken place. Great care must be taken to avoid the presence of any bone-dust in the wound. The ends of the bone being replaced, and the wound carefully united by plaster, the fracture is to be put up, care being taken that the ends are brought into perfect contact, and retained there. The success attendant on this operation is unfortunately not very general; the want of power being rather the result of constitutional infirmity.

EXCISION OF THE LOWER JAW.

The lower jaw is occasionally the seat of disease involving its texture, whether originating from the periosteum or from the internal structure of the bone. It is also liable, in common with other bones, to necrosis. Well authenticated cases are on record, in which the entire of the lower jaw has separated, in a state of necrosis, and partial separations are by no means uncommon. Of the former, the museum of St. Bartholomew's contains a fine specimen, and a second occurred in the wards of the hospital during last year, under the care of my colleague, Mr. Stanley. Diseases arising from the periosteum are generally more or less hard and fibrous in their texture, and of slow growth. These diseases, whether osteo-sarcoma, fibrous tumors, or exostoses, require the removal of the part of the bone from which they arise. When taken early, a section of the bone only may be involved; but if far advanced, the excision of the entire bone may become necessary. But the necessity for this operation is a very uncommon one, the disease rarely extending beyond the angle of the bone. It will be recollected that the ramus of the lower jaw, beyond the angle, is flat and thin, and receives the insertions of the masseter and internal pterygoid muscles. This portion of the bone is less liable to disease than other parts, whether benign or malignant.

Cancerous affections generally originate in the cancelli around the alveoli, and involve the body of the bone, from the angle to the symphysis. Under the various titles of cancerous, fungoid, or medullary tumors, this disease extends, pushing outwards the lower

part of the cheek into a rounded form. In fibrous or osseous tumors of slow growth, the removal of the lower jaw, or a part, is an operation called for by judicious surgery; and may be undertaken with a good prospect of a favorable result, but in cancerous, medullary, or fungoid disease of this bone, the excision of the bone is rarely, if ever, successful in eradicating the disease from the system.

In the year 1836, I removed a portion of the lower jaw from a lady, who had fungous thread-like processes shooting out from several of the alveoli of the lower jaw, on the right side. The teeth had been drawn in consequence of the disease, when incipient. The case was seen by two or three surgeons of competent judgment, and all of whom concurred with me in recommending the operation as the only treatment likely to prove permanently successful. I divided the jaw at the symphysis and at the angle, nearly an inch beyond the part apparently affected, as proved by subsequent examination, and detached the insulated portion. The disease returned within twelve months, reached a frightful magnitude, and destroyed her. In this case we had every warrant for the operation, and abundant promise of success. The disease was comparatively recent, the growth small, the surrounding parts not involved. The division of the bone exceeded the dimensions of the disease, by half an inch in front, and by full an inch behind, and yet it returned with all its violence, involved all the surrounding structures, raised a mass of enormous magnitude, encroached on both trachea and œsophagus, till she was worn out and died.

Excision of either the upper or lower jaw was an operation much in favor with hospital surgeons up to the last ten or fifteen years. Comparatively speaking, it is now rarely performed, and for this reason, that it does not afford the remedy promised; and it behoves all surgeons to pause before having recourse to it, and to ascertain the general, if not the precise nature of the disease for which it is applied: in fibrous tumors of bone, the prospect is a favorable one; in malignant disease most unpromising.

Relative Anatomy of the Lower Jaw.—The jaw articulates with the glenoid cavity by means of the condyle, immediately in front of the meatus auditorius externus, an inch in front of which is the coronoid process, giving insertion to the temporal muscle. The ramus descends from these processes to the angle of the bone, which then becomes horizontal, to the centre or symphysis. On the inner side of the ramus is the dental canal, for the dental artery and nerve,

and extending downwards to the angle of the bone, on the inside, is the insertion of the internal pterygoid, and on the outside, that of the masseter muscle, in front of which the facial artery ascends on the bone. The external pterygoid is inserted into the neck of the jaw and articular cartilage. The mental foramen is one inch and a quarter from the symphysis, opposite the second bicuspid tooth. Attached to the inner side of the bone, and to the base, are the digastricus, mylo-hyoideus, genio-hyoideus, and genio-hyoglossus; on the exterior, the depressor anguli and labii inferiorus muscles; sixteen teeth occupy the alveoli.

The patient should be placed in a high-backed chair, with the head well supported by an assistant. Supposing it intended to remove the body of the bone to the angle, a firm incision should be made along the line of its basis to the above extent. This incision will necessarily divide the facial artery, which will bleed freely, and should be immediately tied. The knife should then be passed upwards into the mouth, separating the cheek along the same line from the gum, the point being guided within, by the fingers of the left hand. When the outer surface of the bone is clear, the knife should be again introduced near the symphysis, *inside* the bone, aided by the fingers employed in depressing the tongue and sublingual gland, to protect them from the knife, and should divide the muscles attached to its inner surface, but chiefly the mylo-hyoid. The attachment of the glenoid muscles to the symphysis may render their division unnecessary. The division of the symphysis will require the application of the saw, and may be completed by the forceps. The masseter muscle is to be raised from its insertion into the angle, and the bone cut asunder as before. The operation is a simple one, may be performed in a short space of time, and leaves little deformity, or other evidence of its extent.

The necessity of removing the ramus also, in addition to the body of the lower jaw, may be either determined previously, or its decision may await the completion of that stage already described. If we have proceeded to the exposure and denudation of the body of the bone, and it is then obvious that the disease extends up the ramus, there is no alternative but its removal. But as every quarter of an inch increases the difficulty of the undertaking, so it may be advisable, in cases of fibrous disease especially, and not of the malignant kind, to divide the ramus, leaving the condyle and coronoid processes untouched. The operator proceeds by a vertical

incision through the soft parts, along the ramus, at about a quarter of an inch from its posterior margin, made down upon the bone. This incision will divide the transversalis faciei artery, the parotid duct, and the portio dura nerve. The masseter muscle is dissected rapidly from the bone. The ramus may then be sawn across, or the condyle exposed and disarticulated, and the insertion of the temporal muscle to the coronoid process divided.

In removing these two processes, the edge of the knife should be kept pretty close to the surface of the bone, in order to avoid the temporal artery, and also to the inner surface of the ramus, while detaching it from the internal pterygoid muscle; by which means the trunk of the internal maxillary artery will also escape division by the knife; but that of its primary branches, the dental and muscular, is inevitable. The flap should be brought into exact apposition, and supported with moderate pressure through the medium of cotton wool, or some soft material.

Excision of the Upper Jaw.—Before proceeding to this large operation, the relations of the bones should be sufficiently studied on the skull. It will be observed that the superior maxillary bone enters into the formation of the nose, forms the greater part of the floor of the orbit, on which the apparatus of vision rests, is connected largely to the malar bone, and forms also the greater part of the floor of the nostril and roof of the mouth. Its relation to the palate bone along the roof should be noticed especially, because this latter bone holds important relations to the velum palati, and should be retained, if possible; and the more so, because it is rarely involved in the disease.

The patient should be seated in a chair, with the head supported, as in the former case. If placed horizontally, the blood will flow backwards into the fauces, to the great annoyance both of the operator and the patient. The middle incisor tooth of the affected side should be previously drawn. The extent to which the malar bone is involved may be a matter of uncertainty. If involved, its removal will form no considerable addition to the extent of the operation. The nature and extent of the external incisions must be in some degree determined by the form and extent of the tumor. The soft textures of the face, composed of skin, muscles, and fat, must be raised from off the maxillary bone; and there are no vessels of sufficient magnitude to qualify the incisions to be made, which are regulated partly by the convenient exposure of the bone, and partly

by the necessary restoration of these structures to their former relations. The lines of incision should be marked in ink.

The first incision, as recommended by Mr. Liston, is made from the external angular process of the frontal bone to the angle of the

Fig. 63.

mouth, dividing all the soft parts down to the bone; a second incision, commencing on the nasal process of the maxillary bone, is carried vertically downwards, through the upper lip, separating the side of the nose, by detaching the nasal cartilage from the maxillary bone. Thus a vertical flap is made, hanging from above. This flap is to be raised, and dissected off the maxillary and malar bones, to the infra-orbitary ridge, dividing the elevator muscles of the upper lip, and infra-orbitary artery and nerve. The dissection is then carried into the floor of the orbit, and the knife employed in separating the inferior oblique muscle, and other soft parts connected with the eye, from the orbitar plate. If it be then found necessary to remove the malar bone, an incision should pass backwards along the line of the zygoma, and reflected from the bone.

The entire of the front surface of the maxillary bone being now cleared, cutting bone forceps, of large size, should be used to divide the malar at its connection with the maxillary bone, or to divide the malar through the zygoma. The next division by the same instrument is made at the external angular process of the frontal bone; and by employing the instrument as a lever, the orbitar plates of the maxillary and sphenoid will be separated into the spheno-maxillary

fissure, or the same fissure will be opened by the first application of the forceps between the malar and maxillary bones. The forceps are again applied to the line of junction of the two maxillary bones, the upper blade being introduced into the floor of the nostril, and again obliquely across the nasal process, towards the nasal canal. The bone, with the diseased mass, is then insulated on its sides, and if forced downwards it will be detached from the ethmoid bone; and, if possible, should be separated from its attachment to the palatine process of the palate bone, which may be effected by a transverse division made along the line of their junction with a strong knife, and the mass removed. The cavity should be filled with lint, and the facial incisions carefully brought into contact, and united by five sutures when all bleeding has ceased.

When the disease in the antrum is limited, and it is obvious that neither the malar bone nor the nasal cavity is affected, the superior maxillary bone may be removed by a simpler proceeding, so far as relates to the external incision, and it is always desirable to incise the face as little as possible. An external incision, commenced below the middle of the orbit, is carried outwards, and running a little beyond the articulation of the maxillary and malar bones, is then curved inwards in a semicircular direction to the angle of the mouth. This flap, which is dissected off the bone and drawn towards the mesial line over the nose, permits the entire excision of the antrum, but leaves behind, undetached, the nasal process of the maxillary bone, and the malar bone; while it permits the division of the maxillary bone from its fellow, or, what may be equally desirable, the cutting through the bone itself a little on the diseased side of the mesial line. But when the diseased growth is of uncertain extent, the larger exposure of surface is preferable, and even necessary.

EXCISION OF THE HEAD OF THE HUMERUS.

Bones entering into the formation of joints that justify excision are mostly softened in their texture and reduced in size. A period of some months or longer may elapse in which a course of treatment has been adopted without success, and during this period the cartilage on the head of the bone, and the bone itself, have undergone a wasting process. In calculating, therefore, the size and extent of the requisite incisions for this purpose, we are not to expect a bone of

the ordinary dimensions of health to present itself, and there is therefore no necessity for an incision of greater than moderate dimensions.

For the excision of the head of the humerus, one of two operations may be selected. The first consists in an incision commencing at the acromion and continued downwards, cutting through the deltoid muscle upon the head of the bone beneath it. This incision should extend to about three and a half or four inches in length. The bone should be cleared of the soft parts, by dissecting laterally underneath the deltoid, the capsule opened freely, and the head forced out of its socket, by using the arm as a lever of the first kind. The head may then be removed at the anatomical neck, or below the line of the former cartilage. The shaft should now be replaced in its former position, the branches of the posterior circumflex tied, if necessary, and the wound carefully united by suture and plaster. It is not desirable to retain it in too high a position.

The objection to this operation consists in the difficulty of suffi-

Fig. 64.

ciently exposing the head of the bone through the fissure made in the integuments and deltoid muscle.

The second form of operation is more applicable to cases in which

the head of the bone is less wasted, and in which we have reason to believe that the glenoid cavity is also involved in the disease. To attain this object, the joint must be more effectually exposed by the separation of the soft parts about it.

In reference to the necessity of removing the articular ends of both, or of all the bones entering into the formation of a joint, it must be recollected that the disease for which the operation is undertaken is not specific in its nature, and still less is it malignant or reproductive. I am myself very doubtful of the expediency of making any considerable effort to remove the articular ends of both bones, believing that, by the exposure of the joint, and the excision of one bone, a sufficient change will be effected in the condition of the joint to get rid of the disease. In proof of the correctness of this view, is the fact of recovery from operations of excision in which a part of a joint only is removed. The excision of the glenoid cavity is rarely attempted, and that of the condyles of the humerus alone is usually successful, although both radius and ulna are involved in the same disease as that for which the humerus has undergone excision.

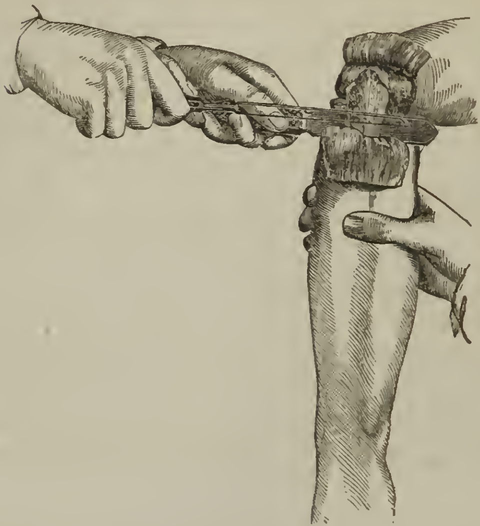
The second operation is thus performed. The arm being as much raised as it will permit without great effort, the integuments and the deltoid are divided by a circular sweep of the knife, made through them with a small amputating knife, from below upwards to the joint, in the form of a flap of the deltoid. The joint may be immediately exposed, and the head thrust out by the assistant, as before, while pressing the arm close to the patient's side. Should it be necessary to remove any portion of the glenoid cavity, it may be readily separated by the oblique-bladed bone forceps. Fragments of bone, if any, are to be removed, the arteries tied, and the flap carefully replaced.

EXCISION OF ONE OR MORE BONES ENTERING INTO THE STRUCTURE OF THE ELBOW-JOINT.

The patient is to be placed in such an attitude as will enable the operator to command the back of the joint freely. He may be placed on his face, or nearly so, with his arm supported on his own body; or the arm, placed in complete pronation, [illegible] rotated inwards, may be supported on a cushion [illegible]. Two longitudinal incisions are to be made [illegible] side of the arm, about two and a half

inches in length from above, extending on to the corresponding condyle. In making that on the inner side, the course of the ulnar

Fig. 65.



nerve must be recollected, and its division avoided. These two incisions, reaching somewhat below the middle of the joint, are to be united by a transverse incision, made deeply into the joint, and the flap reflected upwards cleanly off the bone. This transverse incision divides the insertion of the triceps from the bone. If the bone be sufficiently soft to be divided by the forceps, these instruments may be at once employed for this purpose; but if it be necessary to employ a saw, the thin blade of a spatula, or some similar instrument, should be passed in front of the bone, and between it and the brachialis muscle, a precaution that may be employed without difficulty, if the arm be a little bent. The lower end of the bone may then be removed by a fine metacarpal saw.

Should it be deemed expedient to remove a portion of the two lesser bones, the two first incisions should be continued one inch or more lower down, and a lesser flap than the upper one made by reflecting the integuments from off the olecranon; and the head of the ra[illegible] is exposed by making a longitudinal incision directly upon it; and by pass[illegible] a pair of cutting forceps, it may be divided through its neck, immedia[illegible] the head. The olecranon, if

necessary, may be divided by the saw three-quarters of an inch down the bone, and the coronoid process removed by the forceps. Every loose portion of bone is to be taken away, and the parts placed in apposition, the joint being bent at nearly a right angle with the upper arm, and placed on a splint.

In the performance of the above operation other forms of external incision may be occasionally preferable to that described. The convenient exposure of the bone is the chief consideration.

EXCISION OF THE CARPAL ENDS OF THE BONES OF THE FOREARM.

The difficulty of this operation consists in the intimate relation of each surface of the bones to the tendons of the fingers or wrist. In front we have twelve tendons, on the external surface of the radius three, and six tendons behind the joint. Notwithstanding these obstacles, circumstances occur which render this operation necessary. This necessity refers to dislocation rather than to disease, and in this respect differs from the operations of excision of bone at the shoulder and elbow-joints. It is less applicable in disease, because the carpal bones may be reasonably supposed to be involved, the recovery of which would be less probable than in the cases of the larger bones, where the healthy action might be expected gradually to extend to the diseased extremity, supposing an important source of irritation removed. In cases, however, in which the carpal bones are thrown off the articulating surface of the radius, and the dislocation proves irreducible by ordinary means, or even by the subcutaneous division of one or more tendons or ligaments, then the excision of the bone becomes warrantable, to remove the pain incidental to this accident. Without pain or any other attendant evil beyond the distortion of the wrist, the operation is not a justifiable one.

The joint is exposed on the dorsal surface by two lateral incisions of two inches in length, united by a transverse line made below the projecting bone. The flap being raised, the tendons are exposed, and should be separated from the radius by a knife passed underneath them in forcible extension of the hand backwards. Along this line the fine blade of a metacarpal saw may be readily passed, which being jointed at the point, can be fixed to its back after passing across the tendons. The blade of a knife passed half an

inch under the radial artery, will protect it from injury. The removal of a quarter of an inch of bone will suffice.

In cases of dislocation of the carpal bones backwards, it will be yet more difficult to apply the saw to the radius, and under these circumstances, the cutting forceps may be applied to the first row of carpal bones, which may be removed in detail, which will answer every purpose proposed by the former operation.

A second mode of performing this operation is by exposing each bone on its own side, dividing the lateral ligament, and commencing on the ulnar side, to detach the lower end of the ulna with the forceps, in abducting forcibly the hand. Adduction of the hand for the removal of the radius is then facilitated, and the same proceeding is adopted for that bone. Advantage has been derived from the introduction of a band of soft material, such as a narrow strip of lint, between the tendons and the bones, by which the former have been more fully insulated and protected from the action of the saw or forceps. The flaps should then be replaced, slight extension made, and the arm surrounded with a wet roller, and placed on a splint.

EXCISION OF THE HEAD OF THE FEMUR.

This operation is rarely justifiable, or, when performed, answers any good purpose. In strumous disease of the joint, followed by spontaneous disarticulation, the disease appears to have reached its crisis, and the morbid actions subside. The operation of excision is only indicated in disease of long standing, in which the parts are much attenuated, and when abscesses form about the joint, or around the head of the bone. Under these circumstances, the removal of the head may be occasionally justifiable. For this purpose, the bone may be exposed either in front or behind the neck, but the latter operation is, perhaps, more easily executed. The patient is placed over on the sound side, and supported in this position by a sheet carried round the trunk, and held or fixed on the opposite side. An incision is made longitudinally, to the extent of about three inches, over the trochanter major; and a second incision carried backwards, of sufficient length to expose the neck up to the head. For this purpose the leg must be carried over the opposite limb with some force, in order to facilitate the exposure of the head of the bone, and to bring it within the grasp of the opera-

tor. The ligamentum teres being absorbed, the head may be drawn from the acetabulum, if yet retained within it, and the neck divided with a fine saw.

A second form of operation may expose the bone from the front, the patient lying on the back. The situation of the femoral artery being marked in ink by an external line, a straight incision is made from about an inch below the trochanter major, along the line of the neck, towards the acetabulum, stopping short of the nerves by at least half an inch. The neck being bared, and the capsule opened, the operator will be able to ascertain the extent to which he can command the part to be removed. If necessary, a second incision may be made backwards across the neck of the bone. The head may be disarticulated by the assistant, and drawn sufficiently out of its socket to enable the operator to cut through the bone as before. But of these two operations the posterior is safer and easier of execution.

EXCISION OF THE KNEE-JOINT IN PART OR ENTIRE.

The operation of excision of the bones entering into the formation of a joint is rarely applicable to this large articulation, and should be undertaken, if at all, with peculiar deliberation, for two considerations of the utmost importance stand prominent in the path of the operator. The first relates to the extent of danger to life, and the probability of recovery; the second, to that of the advantage afforded by the operation in furnishing a useful limb for the purposes of locomotion. With regard to the first question, death has been a frequent attendant on the experiment in the hands of Moreau, of Crampton, of Syme, and of Roux; and, certainly, the permanent benefit in such cases as have recovered has been by no means unequivocal.

One mode of effecting the excision of the bones consists in making a crucial incision into the joint, of which the transverse line is formed immediately above the patella, and is continued laterally through the lateral ligaments. The joint is then fully exposed; the patella raised and turned downwards. The leg being then bent on the thigh, a knife is passed into the back of the cavity, and carried upwards behind the condyles, for the purpose of dividing the gastrocnemius, popliteus, and plantaris muscles attached to them. These processes are then sawn off. Should it be necessary

to remove the head of the tibia, the integuments are to be reflected downwards in front of the joint, when the entire articular surface of the bone may be removed without difficulty.

A second mode of performing this operation is effected by the formation of a large flap, similar to that made for excision of the elbow-joint. This is commenced by two lateral incisions made in front of the ham-string tendons, and united below by a transverse line passing through the ligamentum patellæ. This flap is then reflected upwards.

A part of the evil consequences of this operation have, doubtless, arisen from its great and very unnecessary extent. French operators have adopted the proposed removal of *six or eight inches* of length of the bones. If we consider the immense exposure of surface which this proposal renders necessary, we cannot be surprised at the frequent fatality that has attended it. Surely the object of the operation would be answered by lesser incisions, and a far more limited division of the bone. If the joint be opened in front by a crucial incision, or, by what appears to me preferable, a semicircular incision, similar to that formed through the integuments and deltoid muscle, for the exposure of the shoulder-joint which should divide the ligamentum patellæ below that bone, the condyles and tibia may be sufficiently exposed to the eye to allow of the removal of so much as will bring into future contact the healthy surfaces of each; and for this purpose but a small section, probably not more than half an inch of its thickness, is requisite. If this operation can only be undertaken on the conditions which have hitherto regulated its performance, far better is amputation of the entire limb above the knee.

EXCISION OF THE ANKLE-JOINT.

This operation has been repeatedly performed with success, both in this country and on the Continent. To expose the joint, two incisions are made longitudinally, one on the inner side, commencing on the lower part of the malleolus, and extending upwards, of about two inches in length, and the other on the corresponding surface, over the malleolus externus. These are united in front by a transverse line of junction, *through the skin only*, made across the joint. The flap is to be reflected upwards to a sufficient extent to expose the lower end of the tibia. The tendons of the anterior

muscles are to be separated from the bone, and an open metacarpal saw, jointed at the end and fixed, introduced across the bone. The tibia may be protected behind by a metallic plate of any kind: but I should prefer to cut the bone through cautiously, and complete the separation by breaking it with a lever, for which little more than the handle of a strong knife would suffice. The lower end of the fibula should then be exposed, and removed. If it be necessary to remove the articular surface of the astragalus, a flap must be formed by carrying the incisions half an inch lower down, and the front of the bone exposed, a sufficient portion of which may be separated by the small convex, or by Hey's saw. The parts being cleansed, are brought into contact, the flaps restored, and the limb placed on the heel, or in a fracture box; at least, sufficient care should be taken to prevent the foot falling outwards. If there be any difficulty on this head, it is better that the patient be placed entirely on the side.

CHAPTER XI.

ON TUMORS.

LOCAL AND CONSTITUTIONAL.—BENIGN AND MALIGNANT.—CASES FOR OPERATION.—CASES FOR REJECTION. — VARIETIES OF TUMOR. — SARCOMATA.—MAMMARY TUMORS.—EPITHELIAL CANCER.—CANCER SCROTI.

The employment of the knife is more frequently called into requisition by the surgeon in the treatment of tumors, than in any other disease. By a tumor we understand a morbid growth, assuming more or less a definite form, and distinct from what we more appropriately term a mere swelling or enlargement of a part. Such growths, for the most part, occupy the external surfaces of the body. The motives for their removal are founded either on the inconvenience of their presence, or their obstruction to the movements, or other functions of the body, or on their tendency to disorganize parts, and involve in their growth any texture around them. In some forms of tumor the morbid action is purely a local one, involving no structure but that immediately around it, while in other cases the disease appears as the product of a constitutional liability, in the production of which, although it occupies a region only, the entire circulation appears to participate, or perhaps, more strictly, in which the constitution takes early cognizance of, and adopts as its own. This distinction of *local* and *constitutional* tumor is more generally, though often incorrectly, recognized under the terms *benign* and *malignant.*

Another ground of distinction is founded on the greater or less liability to involve in their growth the textures around, whether muscle, tendon, or bone itself. Such a disease is often deemed malignant in its nature, although the constitution may be apparently free from its ravages, and so long as the circulation deposits the material for morbid growth in any remote part of the body only, it is difficult to say how far this growth is dependent on a local action or on a general one. And yet, if the growth be removed

from one part, it will develop itself in another. The pathology of tumors is an exceedingly difficult subject, and notwithstanding various efforts made by eminent members of our profession to subject them to some definite classification, the success has been hitherto very equivocal. If we take the subject of cancer, how uncertain is its diagnosis, and how different the opinions expressed of its probable return, on removal! The variety in these views is founded on that of the disease itself. Cancer is seen as a torpid, sluggish, and painless growth, occupying the mammary gland for years, and often forgotten by its possessor, or has long ceased to create alarm—a hard kernel, involving no texture, apparently insulated from the circulation, and closely resembling in its character and in its history a purely local disease. It is also seen in the same situation pursuing an active and vigorous career of mischief, extending over the breast, contaminating by its touch the entire body of the gland, cellular tissue, and skin, and destroying life in the course of a few months. In the first of these cases we often operate in the early stages with advantage; in the second, death is the result; but in neither case do we find evidence, on examination, of the existence of the same disease in the cavities or internal structures of the body.

We generally attach to the idea of a malignant disease, a growth that, however simple in its nature or composition, has the power, as it increases, of involving other structures around it, and blending them into itself, having a tendency to return, when to all appearance entirely removed by operation, either in the situation of the former wound or in the textures of the viscera.

With regard to the simple composition of tumors, we have examples of the fibrin of the blood almost unchanged, and constituting one of the most destructive growths man is liable to, while another example, most prone to return after removal, and fatal alike to all structures within its range, is composed almost entirely of albumen, and named from that circumstance the albuminous sarcoma. Both of these diseases are malignant. But the above definition of a malignant growth will not universally apply, for no disease is more oppressive in its actions on the neighboring structures than an aneurism, which, as it enlarges, absorbs the contiguous bone to any extent, with the muscles attached to it. Neither will the third part of the definition universally hold, because cancer itself does not invariably return, even during a protracted life.

One mode of lessening the difficulty of the attempt to class tumors, and to distinguish the malignant from the non-malignant, is to take the more chronic forms of cancer out of the category of malignancy, and looking to the indisputable fact, that cancer may remain dormant and harmless for ten years in the female breast, and that the same disease is not reproduced on removal, and also that cancerous tubercles of large size may be found in the liver, and in other organs, of persons who have died from other and dissimilar diseases, we may infer that there is a condition of cancerous disease which does not answer to the definition usually given of malignant tumors. Of course I speak only of cancer in its scirrhous and thoroughly chronic form.

It would appear that, however palpable the line that distinguishes the positive characters of benign and malignant, or local and constitutional tumors, yet, that as each approaches the confines at which the two diseases meet, the difficulty of discriminating the one from the other, in forming an opinion on any given case before the tumor is exposed, is almost insuperable. And in this respect the surgeon has greater difficulties to contend with than the pathologist. It is one thing to diagnose a disease by manipulation, and another by dissection. When called on for an opinion as to the expediency of an operation in any given case of tumor, we judge by manipulation, by our knowledge of the anatomical relations of the tumor; we learn its history, its rate of progress, its physical characters of form, density, &c. The tumor being removed, is then subjected to the closer inquiry of the pathologist, and the microscope may be required to facilitate our decision.

However great the difficulty of forming a correct judgment as to the liability of any given tumor to return after its removal, or rather of deciding whether the rudiments of the tumor are entirely eradicated from the body, yet the necessity for a correct judgment on that subject is by no means invariably required to justify the undertaking its removal by operation. Almost all tumors have a tendency to increase in size. We infer that, if not requisite at the time, their increasing growth will, ere long, demand their excision, and therefore we operate at once, because every day increases the evil, and most especially in the early stages of those tumors which are of a malignant, or even of an equivocal nature. As a general rule, we endeavor to remove all tumors that we can reach, and yet the excep-

tions are sufficiently numerous to require the observation, and to demand the obedience of all prudent members of our profession.

1. We reject the operation in all cases of suspected malignancy, in which the diseased growth extends within the cavities of the body, including in this rule of conduct cases in which the absorbent system, whether of the groin, axilla, or neck, is positively involved in the same disease.

2. We reject the operation in tumors of large size, the anatomical relations of which probably involve important structures or large arteries not accessible to the operator.

3. We reject the operation in large and suspected tumors, existing in a weak constitution, in which the hemorrhage would probably prove fatal, or even very injurious.

4. We reject the operation in quiescent tumors in old age, that will probably survive the life of the person.

5. We hesitate in the performance of an operation for the removal of a tumor, that, having been once removed, has again appeared in the same, and still more if in another locality, in the direction of the trunk.

In disease of the mammary gland, supposed to be of the scirrhous nature, the glands of the axilla are, as is well known, commonly affected. The question arises, what is the real condition of these glands? Is the enlargement malignant or benign in its nature? If malignant, and more especially so, if many glands are involved, the fact should preclude the operation; if benign, there is no benefit derived from their removal. My own observation leads me to believe, that, consequent on scirrhous disease of the mammary gland, and especially of a chronic character, the axillary glands become enlarged by simple irritation, and continue enlarged for a length of time, before they undergo the change which identifies them with the original disease; and, consequently, that the presence of one or more enlarged absorbent glands in the groin or axilla does not necessarily prevent the question of the operation being entertained. If they are numerous and hard in texture, the question of operation should be at once met by a negative. I do not think, therefore, that we gain much by prolonging the operation for excision of mammary tumors, by dissecting into the axilla, and removing often a portion only of the diseased glands. How uncommon it is to see disease returning into the axilla! If the glands are inoffensive in character, it is needless to remove them; if malignant, it is use-

less. This rule may admit of exceptions, but is on the whole a salutary one.

It must be acknowledged, under the most favorable circumstances of glandular enlargement, that their existence is not desirable. Their presence always indicates a disposition in the constitution to identify, or at least to interest, itself in the actions of the morbid growth.

With regard to the question of malignancy, there is no doubt that this character prevails in various degrees. All tumors known as malignant are not equally destructive. If we take hard cancer—I do not include the forms of disease described by Mr. Abernethy, under the titles of *pancreatic* and *mammary* sarcoma, for I really do not know them, but to which he attached some degree of malignancy—and the forms of soft cancer, known as medullary, encephaloid, and fungoid varieties, the malignant actions vary greatly in degree from each other; the extirpation of one by the knife would be justifiable, when, in the case of the other, none but a rash operator would undertake it. The degree of malignancy, therefore, is occasionally an important item in the question of removal, or otherwise; for the disposition to return is by no means equally great in all forms of what are termed malignant growths.

We are justified in removing all tumors, with the above-given exceptions. We operate generally on the principle of prevention. We remove a tumor in its early stages, to obviate its injurious effect on the person in the later; and we operate at an advantage, because we contend against a lesser, instead of a greater evil. Nor can I altogether agree with Dr. Walshe in his estimate of the value of previous treatment. Sooner or later, the operation must be submitted to. The treatment, *quoad* absorption, is nugatory: and it appears to me that the less we molest them by local agency the better. General treatment, that has for its object the improvement of health, such as fresh air, when impregnated with iodine, tonic medicine, &c., is, of course, admissible at all times.

Tumors require removal on various grounds. Some are unsightly, and involve exposed regions of the face or neck; some, because they are inconvenient to the person, or obstruct the free movements of the body. Some are painful, whether in themselves or occasioning pain by pressure on surrounding parts. Some obstruct functions by their mechanical influence, or are likely to do so in the progress of their growth. All such tumors we excise, provided their excision be rendered complete.

The most common form of growth is the encysted tumor, which presents itself in the form of a rounded and well-defined mass, generally movable in the tissue around it. This movable character of tumors is generally indicative of the simple and inoffensive nature of the growth. They are, for the most part, painless, unless molested by pressure, or other form of violence. Encysted tumors are prone to appear about the head and neck, and sometimes accumulate on the scalp in numbers. But in any region of the body, a rounded and well-defined growth, usually not exceeding the size of a pigeon's egg, which rolls under the pressure of the finger, and has existed for many months, and probably years, is more or less elastic to the hand on pressure, gradually increasing in size, and free from pain, is probably an encysted tumor. The difficulty of the diagnosis increases with its depth. The peculiarity of the disease consists in the secretion of the substance of the tumor, whatever modification of the blood that may be, whether what is called steatoma, atheroma, or melliceris, by a firm and thick cyst or sac, to which the diseased actions are confined. When such tumors, situated about the neck, reach an inordinate size, they are termed wens. They have been treated by puncture, but they are liable to inflame, and to become a source of positive danger.

OPERATION FOR THE REMOVAL OF ENCYSTED TUMORS.

The removal of the entire cyst is an object of some importance, and yet not of the importance generally attached to it, for, provided the greater portion be removed, the remainder is powerless for evil, its morbid action being destroyed by the operation. However, it is very desirable, and far easier on the whole, to take the cyst away entire. The depth of the cyst below the level of the skin will best determine the form of the external incision. If protruding from the surface, or lying upon it, two incisions, passing round the base and elliptical in form, meeting exactly at their angles, will leave a straight line for union. If deeply seated, a single incision, of greater length than the diameter of the tumor, will answer the same purpose. When encysted tumors are so situated with respect to other structures as to render dissection around them difficult or dangerous to the structures, also when a cyst is adherent, and not very accessible, the quickest operation is effected by making an incision straight down through the entire body of the tumor to its base,

evacuating the contents, and drawing out each half of the cyst entire. If the cyst, being very thin, burst in the process of removal, and the contents are evacuated in the necessary force required to detach it, supposing a small portion of the cyst to remain behind, if the part be scraped by the knife, little fear need be entertained of the disease being reproduced. I have never seen nor heard of a case of an encysted tumor having returned, however clumsily removed, and should the wound not heal by the first intention, its return would appear still less probable. In cases in which, being often hereditary, many of these tumors occupy the scalp, and may achieve the magnitude of a small orange, some danger attaches to the operation for removing them, unless great caution be observed. Not more than one of the largest, or one or two of the smallest should be taken away at any one time.

When an encysted tumor is removed from the face or neck, great care should be taken in the management of the external wound. (*See* Introductory Chapters.)

One of the most common forms of tumor is the disease called by Mr. Abernethy the *adipose sarcoma*—the fatty tumor. It is, generally speaking, indigenous to fatty regions, and is found about the shoulder and scapula, back of the neck, and nates. It may be known with some approach to certainty, by its tuberculated and elastic feel, caused by the projecting lobules of which it is composed, its ill-defined margin, its slow progress, its painless character. Except when it presents on or about the shoulder or groin, it almost invariably occupies the trunk of the body. When small in size, and situated in the region of much subcutaneous fat, it is composed of small masses or lobules, each of which is more or less encysted by a layer or sacculus, of condensed cellular tissue, and the margin apparently blends with the surrounding fat. When it has reached a large size, as in protracted cases of long standing, the lobules become large in proportion, and their cellular investments strong and almost fibrous. When the integument is closely adherent to the tumor over a considerable surface, the tuberculated character stamps the nature of the disease at once. In large examples of the fatty tumor, situated in the track of cutaneous veins, as the cephalic or saphena, the pressure of the tumor on the venous system produces the growth of an abundance of large cutaneous venous trunks which ramify over the tumor, and give it, in the judgment of some, a malignant character, simply because in some malignant growths a

similar appearance, arising from the same cause, often presents itself. These veins, occupying the skin covering fatty tumors, are very harmless, and may be cut in any direction with impunity, provided the tumor which has caused them be removed.

I removed an enormous tumor of this kind from the groin of a woman, in which the veins were larger and more numerous than I have ever seen them before or since. This woman lived in a country village, and was an object of curiosity to medical virtuosi throughout her neighborhood for miles around. She did not lose six ounces of blood, and recovered. I removed a fatty tumor of about the size of an orange, from below the axilla of a somewhat stout married lady, of about thirty-five years of age, who had borne no children. Her breasts owed their roundness and symmetry rather to the presence of fat than to glandular structure, the place of which, fat vicariously and commonly supplies, I suspect, as life advances. The peculiarity of this case consisted in the absence of the lobulated structure usually found. It appeared to consist of simple hypertrophy of the ordinary fat of this region, and had no definite boundary in any part of its circumference.

OPERATION FOR THE REMOVAL OF FATTY TUMORS.

An incision should be made in the axis of the tumor and down to it. If it be closely adherent to the skin, some difficulty will be found in detaching it with the knife; but the diseased growth must be insulated, and by far the best agent for this purpose is the hand. The accomplishment of this object by dissection is slow, uncertain, and bloody; that by the hand is rapid, sure, and bloodless. As soon as the tumor is sufficiently separated from the surrounding parts, the fingers may be insinuated around and underneath it, and some force employed to detach it from the normal structure around. This may be done with force, but not with violence. It is more sure, because the diseased will more entirely and cleanly separate from the healthy structure around, by tearing than by dissection, for in the latter case the eye is deceptive, and the knife impetuous and arbitrary in its movements; and, lastly, the vessels being torn asunder, will be less likely to pour out blood than when cut across by the knife. Great care and time should be bestowed on the endeavor to arrest all hemorrhage before the edges of the wound are

brought together. The space of the former cavity should be occupied by considerable pressure from without.

The female breast is the most prolific region in the body of the growth of tumors, excepting the two common forms above described. I shall content myself with little more than a mere enumeration of the growths which are here found, referring the reader for a more entire and general description to Mr. Paget's report of the Collection in the College Museum.

The common tumor of the breast is the *fibro-cellular tumor*, the distinctive character of which, during life, is to be obtained rather from the absence of the signs denoting other or more serious disease. It is firm, but not hard; may occur in early womanhood; is usually unattended by pain, although the pain of a tumor is a somewhat uncertain symptom, being often rather dependent on the character of the constitution, both moral and physical, than on the disease, and precluding any great reliance on this symptom when present. It is definite in its outline, and distinct, though irregular, in its form. A part of the mammary structure may be retained in this growth.

Cystic Tumors—containing serous fluid, formed by dilatation of the mammary ducts, and described in an admirable paper by Sir Benjamin Brodie, under the term sero-cystic sarcoma.

The soft structure of the breast around, in which the tumor is imbedded, prevents the elastic character of this disease being rendered very manifest, and the diagnosis is difficult, and often impossible, though sufficient evidence may be obtained of its innocent character, rather from the absence of symptoms than from their presence. Neither in this nor in the former disease are the axillary glands liable to enlargement. The moderately well defined outline of these two forms of growth are not to be confounded with a condition of the mammary gland known by Sir Astley Cooper under the term *irritable breast*. In this disease the cellular structure of the gland appears to be generally involved, and not the mammary substance itself. The whole breast, or a part of it only, retaining its natural form, is converted into a substance firmer than natural; uneven on its surface, and generally more or less painful at the menstrual periods. The disease is diffused over the organ, and attacks the breast at any age. I have seen it just beyond puberty, and it is more common in the breast in which the natural functions have not been called into requisition. It often attacks both glands at the

same time. Either of these tumors may involve and invert the nipple, if near it.

We have the various forms of hard and soft cancer. Carcinoma, though more frequently occurring in later life, may appear at any age, but is generally more formidable when, presenting itself between thirty and forty years of age, it assumes the character of soft cancer. The most malignant forms of the disease, viz., fungoid, medullary, and melanotic cancer, rarely attack the female breast, which is the subject of two forms chiefly; viz., the hard scirrhous growth and the deposition of carcinomatous matter throughout the substance of the gland, involving the skin, or otherwise.

The hard carcinomatous tumor of the breast more frequently occurs above forty-five or fifty; is of slow growth, in proportion as it is chronic in its nature; is generally free from considerable pain, at all events from the lancinating pain assigned to it; is well defined; hard in texture; may be imbedded in the substance of the breast, or lie on its surface; has a tendency to involve the skin by simple adhesion, and when placed near the nipple, draws it inwards. It attacks both women who have, and who have not borne children. The axillary glands are more liable to become affected in this than in either form of disease yet described.

The diffused carcinoma is a much more serious disease than the above. The general texture of a part, sometimes of the whole, of the breast is involved. The swelling is diffused—the breast swells, attended by shooting, irregular pains throughout its substance. It may occur at the early period of womanhood, and appear even during lactation. As the disease advances, the skin becomes involved, participating in the activity of the action within, by exhibiting blushes of discoloration, which appear in patches on the surface. In some cases, these patches coalesce, and the entire skin of the breast becomes involved. In this condition the whole organ assumes a firm and incompressible mass, as though cut out in marble, and throughout the entire stages of advance the nipple may remain prominent. I attended such a case, which was seen by Sir Benjamin Brodie, Mr. Travers, and Mr. Aston Key. It occurred in an apparently healthy lady of thirty-two years of age, and made its appearance during the period of her pregnancy, and within six weeks of her confinement. The skin became involved; the whole breast assumed a marble

hardness; and then the other breast became similarly affected. An operation was deemed inadmissible by all parties. She died within six months, with effusion into the cavity of the chest, in confirmation of the observation of Sir Benjamin Brodie on this subject.

We reject operations for the removal of tumors of the breast that are probably malignant in character when marked by constitutional disturbance, by large size, by rapid growth, by indefinite outline, and by considerable enlargement of the axillary glands. If the disease has advanced to the ulcerative stage, it is an additional element of objection, especially if the exposed surface of the tumor be large, and the secretion from it great. In defined tumors forming in the substance of the breast of apparently healthy persons, unaccompanied by enlarged axillary glands, or by much pain, of slow growth, including all the varieties of simple tumor, and even in that of the chronic form of cancer, when under the most favorable circumstances, we are, I consider, justified in operating. Before the removal of diseases supposed to belong to the malignant class, it is the duty of the surgeon to conceal nothing from the patient or from her friends, but to state openly the liability of the disease to return. The motive for removal is founded on the supposed probability of a longer extension of life with the operation than without it. But even this is a question in many cases of serious doubt, and I can only enforce the necessity of the most deliberate reflection, and no less of forbearance, when I assert that operations for diseases of the female breast become less and less frequent in proportion to the age and experience of the operating surgeon.

A question has been canvassed, founded on the necessity of removing all or a portion only of the mammary gland, in true scirrhous disease of the organ, or in suspected cases of that disease. If the morbid growth be insulated and movable, and the texture of the gland around be unaltered, if the tumor be small in size and give no evidence of being connected or identified with the otherwise healthy gland, and being deeply seated is unconnected to the skin, it does not appear to me necessary or desirable to remove any portion of the gland but that which immediately surrounds it; at the same time there is high authority for the opposite practice. Even if it be identified with the gland immediately around, but still leaving the organ to all appearance otherwise healthy, I do not think any important object is answered by the removal of the entire

gland, provided the operator cuts wide of the disease. In cases in which the removal of the entire breast appears requisite, perhaps the sounder deeision would be one unfavorable to the operation at all.

ON THE OPERATION FOR EXCISION OF MAMMARY TUMORS.

The size and depth of the tumor being ascertained, the lines of incision should be determined on, and if neeessary marked in ink. These ineisions should inelude so much of the integument as will permit of the ready removal of the tumor, and leave suffieient skin behind to unite easily and without effort. The direetion of the lines of incision will depend on the position and form of the tumor, nor is one direction mueh preferable to the other; it may be made oblique, vertical, or transverse. The ehief ground of preference relates to the facility of dressing hereafter. If the nipple be not involved in a case oecurring in early womanhood, I see no justification for its removal. The arm should be moderately extended, unless by being brought to the side it enables the operator to grasp the tumor in his hand and draw it off the pectoral muscle. It is of great importanee to prevent the lavish expenditure of blood often witnessed in these operations; and with this intention, an assistant should always eompress the subelavian artery, while passing over the first rib; and if his duty be well performed, the loss of blood will be inconsiderable. It is of no importanee whieh ineision be first made, whether the upper or the lower, the inner or the outer. The rule formerly prevailed, giving priority to the lower, lest the flow of blood from the upper should obseure the line of the lower incision; but this is not an operation of disseetion.

The knife employed should be a large and strong scalpel, with a thick and firm handle. The first incision should be carried at once through the gland, down to the peetoral musele, on one side of the tumor, and the second, beginning at the point of junetion above, should sweep round on the opposite side. The tumor should be grasped firmly by the hand, and detached from the muscle along its base by a few strokes of the knife. The entire operation does not require more than a minute, and may often be performed in a less period. There is no excuse for cutting deeply into the peetoral muscle, when the tumor is movable upon it; when adherent, the

surface of the muscle should be removed to the full extent of the adhesion.

The old operation, which consisted in the elaborate dissection of a tumor of the breast, on which occasions half an hour or longer time was required to complete it, is all but exploded, and with great reason. I have known one hour and three quarters devoted to a single operation for the removal of a common tumor of the breast. This operation was performed in the infirmary at Edinburgh, as early as the year 1820. The wound should be rendered entirely free from bleeding before its sides are brought together. These may be united partly by suture and partly by plaster, and a compress of cotton wool will complete the operation.

Tumors occur in the neck of various kinds, a few of which only justify the interference of operative surgery. The great majority of these diseases consist of enlarged absorbent glands. It is true that we may have encysted tumors in this region, but they are not of common occurrence; we have also aneurisms, but they are still more rare, and we have various forms of enlargement of the thyroid body. The latter disease is occasionally obscure, especially when one lateral lobe only is affected. It is occasionally attended with some difficulty of deglutition. The isthmus of the thyroid body lying upon the trachea sometimes presents the form of a rounded tumor of the size of a marble, while the rest of the organ retains its normal character: more than once I have had such a case brought to me for removal. The nature of the tumor may be known by its occupying the locality of the thyroid body, and its connection to the trachea may be inferred from its rising and falling in the act of deglutition. Enlarged absorbent glands of the neck, so common in children, rarely, if ever, justify the resort to the knife. We occasionally have one or two become more prominent than the rest, and appear almost insulated; and if a real difficulty to the functions of respiration or deglutition be traceable to their presence, we are justified in removing them; but it must always be recollected that this evil forms but one link in a chain, and so far as my experience goes, such operations, though affording temporary relief, are followed by a rapid increase of the diseased actions, and the majority of children on which such treatment has been resorted to, die in the course of a year or two from the date of the operation.

The name of *epithelial cancer* has been given, of late years, to a modification of cancerous disease, and which is deemed to be semi-

malignant in character. This is the nature of supposed cancers of the lip, of the temples of old persons, of the external organs of generation, and also of cancer scroti. It owes its name to the identity of its microscopic appearance with that of epithelium, the cells in each being the same. There is often, however, more or less of true cancer mixed up with the epithelial disease. In removing such tumors with the knife, there is less necessity to cut wide of the disease, or to take away much of the adjacent skin, than in cases of positive malignancy, this disease being less reproductive, and when we consider the structures attacked by it, this practical fact is important, and may be valuable, especially as regards the structure of the lip and the genital organs.

Cancer scroti is an affection of the skin and subcutaneous cellular tissue, caused by the irritation of soot, which becomes ingrained in the rugæ of the scrotum. From the scrotum it extends forwards on to the integument of the penis, and backwards to the perineum. Its progress is very slow, and the disease very chronic. However extensive, it rarely attacks the testes or the body of the penis, although, in an advanced stage, either structure may become adherent to the diseased growth, but this adhesion is an exception, and not the rule. In extreme cases affecting the skin of the entire organs, the fissure of the thigh, and even the inguinal regions, although it was formerly the practice to remove the testicle and even the penis, I do not recollect to have ever seen these structures involved in the disease. In one case the scrotum was entirely removed, and the testicles bared of the whole of their natural investment, but a new and tight scrotum formed over them, and the patient recovered. The fibrous tissue of the penis, as also the tunica albuginea of the testicle, appears almost insusceptible to the action of the disease.

The verrucous-looking growth should be dissected carefully from off the testicles, and the tunica vaginalis left untouched if practicable, and, in like manner, detached from the fibrous structure of the penis. Some additional care will be required in removing the diseased structure from the corpus spongiosum. If the perineum be involved, the patient should be placed in an attitude similar to that for lithotomy. In this locality the diseased actions extend somewhat more deeply, but the bulk of the spongy body forms the guide, and below this object the presence of no vessels or other structures exists to preclude the entire removal of the disease.

The more malignant form of disease, known under the terms *fungoid*, *medullary*, *encephaloid*, and *melanotic cancer*, more generally attack the lower extremity than any other region. I have known the head of the fibula its frequent seat.

OPERATION FOR MALIGNANT TUMORS.

The nature of the disease may be suspected by the diffused character of the swelling, which cannot be made to suppurate or to yield to ordinary remedies. As the swelling enlarges, the skin becomes tight and shining, the absorbent system of the limb is affected, and the leg swells below the tumor. By slow degrees of continued and uninterrupted increase, the swelling becomes enormous, involving all the textures of the limb in its growth, more especially the bone and the muscular system. The tumor conveys to the fingers, on pressure, a sense of elasticity, which is greater in some parts than in others, and also of obscure fluctuation, as though its contents were fluid. This last symptom has deluded many, I may say most, and the tumor has been punctured again and again, under the idea of evacuating fluid, but little more than a few drops of bloody serum escape.

Sometimes these malignant growths are tolerably well defined, and firm throughout; so firm, indeed, as to give the impression of a fibrous tumor; so uncertain is our knowledge at the present day on the subject of tumors, for definition of the margin of a morbid growth is a bad criterion to rely on invariably, although, as a general rule, we may often derive a valuable hint from its presence, or otherwise.

The only remedy, and that of very uncertain efficacy, is amputation far beyond the disease. To detach such a tumor by dissection is impossible, all parts being equally affected. It would be inexpedient to bare the bone or the muscles, and supposing the artery, vein, and nerves to pass through its substance, it is not possible that the cellular investment of these structures will be free from contamination. Before entering on the operation, not only in the case of this form of disease, but also in that of many doubtful forms of tumor, it is always safer to introduce a fine trocar or a grooved needle deeply into the morbid mass, in one or even two situations. It is even better than this, to make a deep incision into it. It may prove to be an abscess or a cyst, or to contain fluid blood, not that

this latter result would necessarily rescue the patient from the alternative of amputation.

With respect to all tumors of a doubtful nature, surgeons cannot be too cautious in their diagnosis; the best judgments fail, and the highest authorities are the least prone to express an opinion of their nature.

CHAPTER XII.

ON BURSÆ AND GANGLIONS.

Bursæ are either natural or adventitious. In many or most of the salient points of the body, in the neighborhood of which the skin is connected to bone beneath, by means of cellular tissue of a peculiarly loose texture, the frequent application of an irritating cause, such as friction from a weight moving upon it, has the power to convert the cellular tissue into a cyst, having all the characters of a natural bursa. These formations are occasionally found, in persons engaged in carrying weights, to occupy the whole line of the spine of the scapula and the acromion process; and, indeed, many of these affections are adventitious that are classed, as I believe erroneously, among the natural bursæ. On the same principle we have the frequent development of one or more cysts along the line of tendons, whether on the back of the wrist or hand, or on the dorsum of the foot.

These swellings are both unsightly and inconvenient; moreover, they are often a source of pain and of obstruction to the free action of the part with which they are connected, and the necessity for their removal requires the aid of operative surgery. These bursal sacs have long possessed the repute of great irritability. The records of surgery point to this fact, and have impressed the minds of modern surgeons with fear from violence done to them. How far this apprehension be well or ill founded, is, I think, a question not finally disposed of by the authority of the profession. When we consider the comparative infrequency of the resort to operative surgery during the last century, from which period the principle I allude to may be dated, and the natural obedience to venerable authority, when dictated by our progenitors, the tendency in the mind to mistake age for experience, and to attach an importance to the impressions of our early life, may we not reasonably pause and suggest this question, like many others which have descended from

our fathers, viz., whether the reputed irritability of bursæ is quite as great as it has been represented?

My impression is, that we have adopted the fears of the old school of surgery, forgetful of our own enlarged powers of treatment and our improved knowledge of the economy of the body. I have seen sufficient to enable me to bear testimony to the uncontrollable nature of an irritated bursa; but I have not seen, under opportunities as extensive as fall to the lot of most men, evidence of that peculiar liability to inflammation and its consequences sufficient to justify the traditional susceptibility furnished by the history of the past, nor have I seen its occurrence with such frequency as to impress my mind with the conviction of its greater tendency to inflammation than any other simple texture; though I am ready to acknowledge that, when a bursa is highly inflamed, its actions are often more than ordinarily violent.

The communication of bursæ with a neighboring joint is an occasional, but not so frequent occurrence, as supposed. We have such an instance in the bursa underneath the subscapularis muscle opening into the shoulder-joint, and it is almost the only example found in the healthy body. Certainly the bursæ under the psoas and semi-membranosus muscles do not often communicate with their respective joints. The small sacs found on the line of superficial tendons, and known under the name of ganglions, I shall consider separately.

The most common form of this disease, requiring treatment, is that on the patella, and known under the name of the housemaids' bursa. It is caused by kneeling, and is, I believe, more frequently an adventitious than a natural formation. It assumes, when diseased, the form of a rounded swelling, varying in size from that of a walnut to that of an orange, and is exceedingly inconvenient from its locality, and is often, though not very generally, found on both patellæ. The skin covering them is pale, and the tumor underneath may present any degree of density, from that of a soft fluctuating cyst to a firm fleshy substance. In the first case, the contents of the sac are serous; in the second, the diseased actions appear to have expended themselves in the heaping up of a thick, dense, fibrous wall, surrounding an exceedingly small fissure-like cavity in the centre, which is generally empty of fluid.

These tumors have sustained a tolerably long contention against

leeches, blisters without number, and liniments in every variety, and will be generally found to have come off victorious in the struggle. Excision has been resorted to, from the effects of which I once traced the body of a poor girl into the dead house. It was an operation of expediency. (*See* Introductory Chapter.) I may assert with truth that I have treated at least a hundred cases with success, and generally without being attended with the loss of more than a few days' work to the subject of the operation.

The principle of this treatment consists in promoting suppurative action in the sac, and of converting the torpid growth into an abscess. This is effected by passing a single thread through the body of the tumor, and through the cavity in its centre, if the tumor belong to the hard and most chronic forms. My directions, when given to hospital patients, are to require the thread to be withdrawn at any time, should pain or inflammation arise. The general average of time requisite is about four or five days, when a blush of inflammation appears about the orifices of the thread. If the thread be allowed to remain more than a day or two after this period, if the instructions be neglected, or if the patient indulge in violent exercise or active motion, the inflammation will often extend and assume the character of erysipelas, and an attack of illness is inevitable.

Unless the patient be seen each day, the order to remove the threads on the occurrence of pain, &c. should be imperative. This application converts the fluid containing cyst early, and the hard, fibrous tumor somewhat later, into an abscess. The abscess is opened, or bursts if neglected, and the cavity and substance altogether are obliterated.

The same treatment may be applied to bursæ on the olecranon, and in any part of the body in which the disease is placed immediately underneath the skin.

A large bursa is found under the insertion of the semi-membranosus muscle. When the knee is bent, the tumor rolls under the tendon, which conceals it from observation. On this account it has been supposed that its fluid contents passed into the knee-joint. When the knee is straightened, the tumor stands out prominent and hard. I have known this bursa to contain from twelve to fifteen ounces of fluid. In passing a thread through this and similar sacs of large size, I should keep the patient at rest in the horizontal posture, and withdraw the thread early.

GANGLIONS.

These small sacs form about the back of the wrist and fore-arm, and also on the foot and about the ankle-joint. I have seen two cases lately of the same disease occurring at the root of the thumb, by which the radial artery was raised, and supposed to be aneurismal.

The common practice is to break the sac with a blow from the back of a book. Unfortunately the operation is often unsuccessful both at the moment and in future. The blow is struck, causing severe pain, and the sac is unbroken, and even when broken and the fluid contents infiltrated into the cellular tissue, the sac often heals and the disease continues its career of annoyance as before. I have rarely, though I have occasionally, failed to cure ganglions, when placed immediately underneath the skin, by making a simple puncture with a fine lancet. The opening must be sufficiently large, however, to allow of the escape of every drop of the albuminous fluid contained.

The sac is then to be firmly compressed by plaster, and a roller applied, and in two days the disease is cured. If any proportion of the contents be allowed to remain in the sac, the sides cannot be brought into contact, and the disease will return. If the puncture fail the first time, I have found it generally fail the second. Under such circumstances, I have recourse to the thread, and should this be unsuccessful, we have no alternative but that of laying the sac entirely open or of removing it altogether. It is only recently that I have obtained some explanation of the cause of failure of the operation by puncture in destroying the ganglion of the wrist, or elsewhere. In the early stages of the disease, the sac is placed upon the tendon, and limited to the tissue lying between it and the skin above. But later in its progress, and particularly after the resort to pressure, the sac extends around, and beneath the tendon to its under surface. If the sac has thus extended itself, it is exceedingly difficult to evacuate its contents by the pressure of the finger; a few drops may yet remain to separate the walls from each other. If such a tumor be evacuated, it is almost impossible to retain the opposing surfaces in such apposition as will insure obliteration. The slightest movement of the hand and fingers detaches the surfaces from each other, and the disease returns. If it were practicable to avert this liability,

to place the hand in a splint, and to make very considerable and very inconvenient pressure on the sac, I imagine the end would be obtained. When, having otherwise failed, we resort to the expedient of removing the cyst by the knife, care must be taken not to dissect the exposed tendon unnecessarily, and to prevent the union between the tendon and the skin.

Collections of fluid occasionally occur in the bursæ placed between the flexor tendons of the wrist and the anterior annular or carpal ligament. The loose texture of the walls of this cavity permits great distension of the sac, which enlarges upwards above the carpus and downwards into the palm. Fluctuation is perceptible in both situations, and the communication between the two is sufficiently distinct on pressure. These collections often contain a large quantity of bodies resembling melon-seeds in form and size, the presence of which would alone preclude the hope of benefit from the introduction of the thread, although other reasons might be assigned for the rejection of this remedy. The best treatment is that recommended by Mr. Syme, viz., that of laying open the sac very freely. I do not consider it necessary to divide the cavity so entirely as practised by Mr. Syme, who includes in his incision the annular ligament itself. If an opening of an inch or more in length be made, and the contents pressed out, a piece of lint may be introduced into the cavity by the presence of which suppuration will be established, and the cavity obliterated. The incision should be made above the carpus, and at the most prominent part of the swelling.

CHAPTER XIII.

OPERATIONS APPLICABLE TO SPECIAL LOCALITIES.

ON THE HEAD, FACE, AND NECK.

OPERATION FOR ELEVATING DEPRESSED CRANIAL BONE.

When a cranial bone is depressed, and requires elevation by the surgeon, with a view to obviate the consequences of certain symptoms attendant upon fracture, we have occasional recourse to the use of the trephine. But the trephine is a bad instrument; too large in size, and not sufficiently delicate for the required purpose, and has been deservedly superseded by modern surgeons in the large majority of cases of fracture of the cranial bones. To the modern improvement in mechanics may probably be attributed the rareness of these cases of fracture, that formerly were so abundant in our London Hospitals, and to these two causes may be assigned the fact that the employment of the old trephine is almost exploded. The instrument now resorted to consists of a small saw first employed by Mr. Hey, of Leeds, and bearing his name. Of this instrument there are various modifications of form and size now in use, which are found far more convenient and more efficient than the old circular saw. The operating surgeon should possess several. They will be found serviceable not only in reference to injuries of the cranial bones, but also to operations on bony structure in other parts of the body.

The grounds on which the employment of these instruments for elevating depressed cranial bone is placed, are the presence of symptoms of compressed brain following an accident. Without the accident, always ascertainable, we have no ground for the suspicion of depressed bone. After an accident, with the usual symptoms of loss of sensibility, more or less stertor of the respiration, a laboring pulse, a pupil deviating from its natural size, but generally inclined

in the direction of enlargement, we are required to cut down and expose the bone.

The necessity for the interference of operative surgery is differently estimated by different authorities. We may have symptoms without fracture, and fracture without symptoms. Mr. Abernethy and Sir Astley Cooper justify the refusal to operate on the bone, almost to whatever degree depressed, provided the depression be unattended by the above symptoms. On the other hand, Mr. Pott and his predecessors consider the presence of depressed bone, although unattended by symptoms of compression of the brain, to be a full justification for interference, and in this view Mr. Guthrie entirely concurs, believing that, although the evidence of injury to that organ be not manifest at the time, yet that the evil is only masked for the moment, to appear in a more formidable character hereafter.

The part is often readily discovered by the presence of ecchymosis, or by other indications that are unequivocal, and through which an incision may be made in any direction. If through the temporal muscle, the muscle must be sacrificed by cutting across its fibres, if necessary; the value of the muscle is as nothing compared to the urgency of the case, though the old authorities appeared to have thought otherwise. The temporal artery should be avoided, if possible; every supra-cranial structure must be sacrificed to the necessary exposure of the bone. When exposed, the line of fracture should be followed to an extent sufficient to command it with facility. This may be effected by a second incision at any angle with the first. When the bone is fully exposed, and the introduction of the elevator is prevented by the wedging in of the bone, a portion of the non-depressed bone must be removed, for the purpose of making room for its introduction. This will be best effected by a short saw, either by that invented by Mr. Hey, or by some modification of it. A convex saw will be most convenient for the operator, but a straight instrument will be safer. During the act of sawing, a probe should be employed frequently to ascertain the depth of the fissure, and the last portion should be broken by the elevator employed as a lever of the first, not of the second order. The fissure thus made should have removed a portion of bone not wider than the one-eighth or the sixth of an inch. The elevator is now employed for the purpose of raising the depressed bone, underneath the edge of which it is placed, and raised either on the left hand, or

on the adjacent bones, as the fulcrum. When the bone is elevated, the loose portions, if any, are removed, and the wound cleaned; the integuments should be replaced and united by plaster. Operative surgery has done all that can be required of its agency.

A small trephine is occasionally called into requisition in cases of disease of the dura mater, or of suppuration between that membrane and the bone. The diagnosis is very difficult and uncertain, and the operation should only be resorted to on the most careful and anxious deliberation.

RHINOPLASTIC OPERATION.

We are sometimes called on to remedy the distressing deformity occasioned by the partial or total loss of the nose, whether from disease or accident, by the operation of rhinoplasm. When the nose is entirely destroyed, the openings of the meatus are completely exposed, conveying a most offensive expression to the observer, which the resources of art alone can remedy, or at least ameliorate. No condition of face can perhaps be worse than that in which the eye at once penetrates the commonly hidden organization of the nose and fauces, except, perhaps, that compound of evils which results from a total failure of the attempt to remedy it. And such is usually the consequence of a first ill-planned, unstudied operation, which has for its object the imitation by art of the form and outline of the natural organ. There is no operation in surgery that requires more calculation and more careful study than this. The surgeon should pay many visits to his patient for this express purpose. No execution can be good, the design of which is imperfect. It exhibits the height of ignorance of the Taliacotian art for a man to take the knife in his hand with the intention of supplying so serious a loss as the human nose, who has not planned his operation in all its points with the utmost precision, and determined on the minutest detail. Without such care failure is certain, and the result inevitable; the patient is disappointed, and with reason, and the art is justly stigmatized as ineffective.

The nose is partly bony and partly cartilaginous. The lower half, or rather more than half, is composed of several portions of cartilage, two of which form the outline of each nostril, and two above, the alæ; a fifth cartilage forms the lower and anterior part of the septum nasi, and the lower edge of the septum is called the columna.

The disease to which the destruction of the nose may be usually assigned is *lupus*, which, having involved the cartilaginous structure, leaves the bone untouched. Occasionally the ossa nasi are also destroyed; and I believe we may then infer that such a patient has employed mercury largely, for supposed syphilitic or venereal disease. If the bones be entire, the operation is more likely to be a successful one. If the bones be destroyed, the condition of the patient precludes the resort to the best operation, and the result is far less promising, from the loss of the arch on which the superstructure is laid.

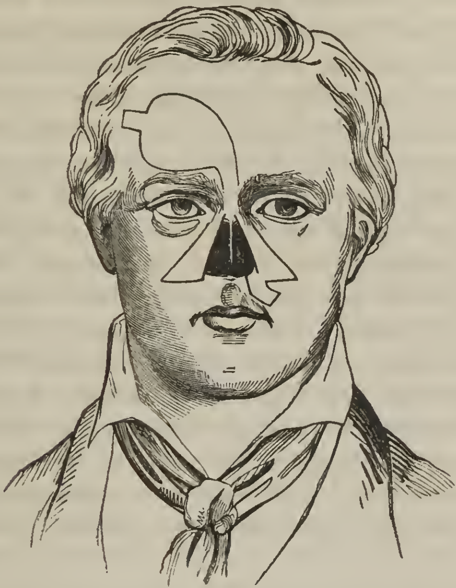
The rhinoplastic operation should be solicited by, and not forced or even urged, on a patient. Without the employment of chloroform, its performance is attended with great pain, which should be duly represented to the person, as likewise the duration of the operation, which is necessarily a very protracted one. No attempt should be made until all disease has ceased for some months. And yet, on the other hand, I made a nose for a young woman having the last vestiges of lupus still hanging about her face, and the case turned out excellently well, so well, indeed, that Sir Astley Cooper told me it was the best nose he had ever seen.

Before proceeding to the operation, the dimensions of the required organ should be carefully made in card or paper. The new material is taken from the forehead, and connected on the root of the nasal bones by a narrow stalk-like process. When the flap of integument is insulated, this stalk is twisted, so as to enable the part to be brought down vertically. The integument should be removed longitudinally from either half of the forehead, running out towards the temple, in order to render the twist as inconsiderable as possible; and when the admeasurement is completed, at least a quarter of an inch on all sides should be allowed for the contraction of the skin. In fact the flap can hardly be made too large; and it is surprising how slight a stalk is requisite to carry on the circulation. When the card has been fitted over the meatus, it should be laid out on the forehead, and all its dimensions extended and marked in ink. The part that is to represent the columna should be very broad, probably more than half an inch.

The operation, which is performed nearly in the horizontal position, is commenced by paring the margin around the nose pretty freely, in order that the exposed edge should be sufficiently large to receive the corresponding margin of the new integument, and the skin on the lower surface of the ossa nasi should be entirely removed by the

knife. When this stage of the operation is completed, a deep incision should be made along the inked line on the forehead, slowly and cautiously, for one slip of the knife may render the whole ope-

Fig. 66.



ration nugatory. The lower edge of the incision will pass across the fibres of the corrugator supercilii, which muscle must be detached with the integument. If the knife be so held as to slope a little inwards, it will give an acute angle to the cutaneous surface of the flap, by means of which the two surfaces may be adjusted with more precision as regards the continuity of surface. When the flap is detached in every part except at the stalk, which of course is most carefully preserved from injury, the wound should be left to bleed, and no attempt made to adapt the surface until the bleeding has *entirely ceased.* Before leaving the flap, it is better to scoop out a little of the substance along the central line of the columna, in order that, by being hereafter compressed, it may fold together, and resemble as much as possible the original structure. When brought down, the columna should be first united to the raw surface made for its reception. There is some difficulty in applying the suture in this situation, from the density of the structure forming the base of the nose. For this purpose, a much curved needle should be

employed, which should embrace a considerable piece of the cartilage. It may be advisable to employ two sutures, instead of one. The sides are then first united by about three good-sized sutures, and the intervals as exactly adjusted as possible by the aid of six, eight, or ten of the finest sutures that can be employed. The nostrils should be elevated by means of pieces of cork and cotton wool, and general pressure of moderate force made laterally with the same material, and a bandage; care being taken to prevent all pressure on the dorsum. The wound on the forehead should be drawn together with good plaster. At the expiration of about a month, or as soon as the new parts have firmly united, the lump always caused by the twisting of the stalk should be pared away, and the knife applied to remedy any positive deformity in the line of the cicatrix. I have done this operation many times; and, except on the first occasion, with some success. In two cases the deformity was so completely removed, that even the companions of the individuals never suspected that they had been the subject of operation; and this success I attribute to care and deliberation in the performance, and to the exact adjustment of the edges of the wound, by means of the finest needle that I could have made, compatible with sufficient strength to resist the force requisite to penetrate the skin and cellular tissue.

It will occasionally happen, after some days from that of the operation, that the new structure begins to lessen in size, and continues to diminish, till it becomes almost absorbed. My experience in nose making, though not small, is not sufficiently great to enable me to explain this fact, whether owing to the small size of the stalk, or to the want of general activity in the circulation—but such is the case.

I had at one time two cases of rhinoplastic operation in St. Bartholomew's Hospital, a young man and woman. They occupied two opposite wards on the same floor; became much interested in each other's case, and exhibited some sentimentalities, which led to an offer of marriage by the man. The girl had undergone the operation with success—the issue of the man's case was prospective. The girl did me the honor to make me her confidant, and to ask my advice. I told her to wait the result of the operation on the other case. She did so; and, finding the new structure to have undergone the change I have alluded to, she declined further intimacy.

In cases in which the ossa nasi are destroyed, an operation has been adopted by Mr. Syme, which, under the circumstances of difficulty, has generally been highly successful. It consists in bringing to the mesial line two lateral flaps made from the side of the nose upon the cheek. The calculations in this operation are nearly as important as in that last described. The outline of the nose is to be prepared, as in the former operation. An incision is commenced at the root of the nose, as nearly as possible on the dorsum, and carried down as close to the line of the former organ as the condition of the skin will permit, and a second, commencing about half an inch on the outer side, should extend downwards, curving at the same time a little outwards, to avoid the orbicularis muscle. The second incision should diverge from the first towards the cheek-bone, and at its extremity, which should correspond with the line formed by the base of the nostril, should be distant more than a full inch from it. It is desirable, if practicable, to make the column at the same time, and it may be effected by carrying the first incision at its lower extremity inwards, at right angles with the vertical line, to the extent of a quarter of an inch, and then continuing the line downwards and outwards above the angle of the mouth, to the extent of three-quarters of an inch. A second line, commenced half an inch outwards, is to be carried upwards into the line which forms the base of the triangle, to complete the columna. The two descending lines may then be united, and the same process adopted for the other side, with the exception of the additional process required for the columna, which is made entirely from one side. If made from both, probably it would not retain its vitality. It seems to me that this attempt to form the columna, when practicable, is preferable to that formed hereafter from the upper lip. Should it fail, the lip may yet serve our purpose. The two flaps should be separated to some depth from the surface beneath them, and brought to the mesial line, along which they are to be united by suture, and the outer edges adjusted to the bared edge already made to receive them.

All these operations should be performed with a very thin-bladed knife, so much depends on the neatness and precision of the lines of incision. The nostrils should be retained by cork or other suitable means of rendering them permanently patent; this is one of the chief difficulties consequent on the operation. The wounds in the cheek should be brought together by plaster, and the eventual deformity from this cause is comparatively little; it is, however, something

worthy of consideration, in calculating the advantages of one or other operation, as is also the injury done to the muscles of the face. In injuries of the nose of lesser degree, sufficient material is obtainable around from every side, to remedy the defect, if well selected. Small flaps may be raised from the cheek, after the manner recommended by Mr. Syme, and adapted with all nicety to the surface to be filled up.

POLYPUS NASI.

The benign polypus of the nose is known by its whitish color and shining aspect, protruding into the nostril, and generally lying between the inferior spongy bone and the septum nasi. It is destitute of pain, and is very imperfectly supplied by vessels. Sometimes it appears more fleshy in its nature. A polypus nasi is affected much in regard to its dimensions by the state of the weather, contracting in a cold and dry atmosphere, and becoming relaxed, and descending low in the nostril in moist. It can therefore be more readily attacked in the latter.

The most common mode of detaching it is by the aid of forceps of different shapes, suitable to the aperture which they are required to enter. Sometimes the growth is sufficiently firm to be detached entire at the first attempt at extraction, and the whole polypus comes away from its root, but more frequently we are required to extract it piecemeal, in consequence of its readily breaking up under the necessary extension and pressure of the forceps. When entirely removed, to all appearance, polypi of the nose are yet liable to return. The plan I adopt, in regard to soft polypi, is one which affords a more efficient result than that obtainable by the forceps. I pass up a loop of fine copper or iron wire, conveyed through a double canula. The form of the loop and the size are adapted to that of the polypus and of the aperture through which it has to pass. This loop is carried up the nostril, embracing the growth, and manœuvred around its base by a gentle movement of the hand, and the wire is then drawn tight. By this mode I have often included so much of the polypus as to afford great and immediate relief to respiration through the nose; I have also used silkworm gut. In cases of great difficulty, I am inclined to think that benefit might be obtained by the application of a hollow cylinder with a piston into which the tumor might be forcibly drawn and divided. I have no

experience in the application of such an agent, but in some cases of difficulty it would be worth the experiment. I have also obtained occasional relief by pressure, from the application of lint or cotton wool forced into the nostril by means of a director. Whichever of these agents be employed, it should be threaded by a piece of thread or silk being passed through it to facilitate its entire removal.

HARE-LIP.

On the more or less perfect result of this operation depend the appearance and expression of the individual for life. Hare-lip may be simple, affecting the lip only, or complicated by defective bony organization of the palate. In the first form we have a simple fissure; in the second, we have in the interval of the fissure a small projecting process of the superior maxillary bone, covered by a thin skin, and the fissure extends upwards into the nose. This piece of bone must be removed before the attempt be made to obliterate the fissure, and may either be detached by the forceps, or forced backwards by partially separating it behind by the same instrument. I have attempted this on two occasions, but not with much success.

The operation for hare-lip may be performed at almost any age, but should not be undertaken under about six months. The surgeon should first ascertain that the opposite surfaces will readily meet without effort. If force be required for this purpose, the lip should be detached from the gum to the extent of half an inch or more on each side. An incision is made at a distance of about the eighth of an inch or less from each edge, removing all the intervening integument, and forming two flat surfaces for future contact. In consequence, however, of the greater extensibility of the lower than the upper part, the result of the operation for hare-lip is to leave a permanent deformity, caused by the retraction of the cicatrix, and the formation of an angle below, at the point of union. To obviate this evil, the lines of incision should be curved inwards. A fine scalpel is the best instrument to be employed for this purpose, with which the incisions should be dexterously and

cleanly made. When these two edges are brought into contact, the upper lip will be found to project downwards in the centre, and this evil time will rectify, by bringing the surface of the lip into a straight line. The necessity of removing a larger portion of the lip by this than by the straight incision is a small objection only, for the ex-

tensibility of the material will readily admit of contact, and that is all that is required. Young operators are prone to remove too little.

The bleeding from the coronary arteries is sometimes considerable, but a ligature is, of course, inadmissible. The opposite surfaces, being adjusted with the greatest precision, should be fixed by means of two needles, which should be passed by means of a porte-aiguille through nearly the entire substance of the lip. The most important part of this union is that of the lip itself. A thick silk thread is passed across and around each needle in the figure of eight. It is not desirable to include the two needles in one and the same thread. The parts should be drawn together with sufficient force for entire contact, and the intervals between the needles, and particularly the lip itself, should receive one, two, or three fine sutures, to insure the contact of the entire length of the wound. The needles should be removed with a gentle hand, if union be complete, about the sixth or eighth day, or at any earlier date, should a blush of inflammation appear around them. If union fail, but no inflammation appear, the needles should be retained, to afford the chance of union by the second intention.—(*See* CHAPTER ON WOUNDS.)

LIPS.

When epithelial cancer attacks the lower lip, there is no alternative but the removal of the disease by excision. The form of operation depends on the extent and relations of the morbid growth, whether it extend more in the transverse direction, along the line of the lip, or more vertically towards the chin. Sometimes the lip is not involved to a greater depth than half or three-quarters of an inch; and, under such circumstances, the disease may be sliced off horizontally; the gap thus made being partly filled up by nature. If the disease involve the parts below, the operation for hare-lip is more expedient, by making two oblique incisions, meeting in a point below the disease. In this manner full half the lip may be removed, without ultimate distortion to the features. Should the morbid growth, or other form of disease, requiring removal, involve the entire lip, and extend towards the chin, an entirely new operation must be resorted to, on the principle identified with the name of the great Taliacotius. The diseased lip should be removed by a quadrilateral incision around it; the two vertical sides, com-

mencing at the angles of the mouth, are to be carried downwards as low as the disease extends. These two incisions are united by a transverse line, made below the growth, horizontally, and the part is to be detached from the bone and removed. A flap is now to be made from the chin, equal in size and form to the part removed, or rather larger in each direction, which is supplied with blood by two stalks brought down from the cheeks. These processes should be about one-third of an inch in breadth, and an inch and a half to two inches in length, commencing one inch below the malar bone, and joining the square flap at its upper angle. The flap being separated, is brought up from below the chin, and fixed by suture all around the wound, care being taken to raise it sufficiently high to represent the lip, and to insure its healing without becoming entirely adherent to the gum. The wound below is brought together by plaster. These operations, when carefully performed, do exceedingly well, and form an admirable substitute for the old lip. In a case in which I performed it in the course of last summer, a cancerous tubercle occupied the line of the right stalk, and the disease was altogether very extensive. I was compelled to take a circuitous course in order to avoid it. The man, however, recovered, and was very proud of his new acquisition.

In operations for the removal of large tumors on the gums, which require enlargement of the mouth, it is better to divide the soft parts along the base of the jaw, and to expose the tumor in that direction, than to distort the face by an unnecessary incision, adopting the plan recommended in excision of the base of the lower jaw. The skin and platysma muscle may be divided to any reasonable extent along this line, which may be even carried beyond the centre, should that be requisite; and I should myself prefer a vertical incision made upon it, if necessary, to the consequent disfigurement of the face, incidental to an incision carried into any part of the mouth.

RANULA.

The disease known under the name of *ranula* is commonly of small size, occupying the sublingual region of one side, but encroaching also on the other. It consists of a sac, supposed to be formed by the dilatation of the submaxillary or one of the sublingual ducts. It presents a bluish color, and vessels are seen ramifying upon it,

and it is elastic to the touch. In size ranulæ vary between a horse-bean and a small orange. The contents consist of inspissated saliva, quite transparent. If punctured, they fill rapidly; and, in consequence of their great tenacity of existence, portions of the sac have been cut out, and caustic applied to the interior of the sac. When of very large size, the walls of the cyst are proportionately thick and flesh-like. The most efficient treatment consists in merely passing through the body of the cyst a needle armed with silk of moderate thickness. The silk should be loosely tied, and the ends cut off. In the course of a few days, the tumor will be obviously diminished in size, and will continue to lessen till the ligature will probably be found at the side of the cyst which has contracted beyond it. The thread should be cut and extracted, and a second thread introduced through the reduced sac, by the agency of which it will be finally absorbed.

Some years ago I attended a young lady with Mr. Jolin, who had a ranula of the largest size I have ever seen. Her mouth appeared to have no cavity. The tongue was forced back against the soft palate; she could not swallow without a great and painful effort, and even her respiration was affected. It had the appearance of a large tumor occupying the mouth, of which the walls were firm and thick. I introduced a single coarse thread of silk through it, and in a week it was reduced nearly one-third in size, and then another and so on; till, at the expiration of six weeks, scarce a vestige of the disease remained.

Epulis is a disease of the gums, attended sometimes by extensive swelling of the structure, and often involving the breadth of several teeth. Its precise nature is not well known. It is considered by Mr. Cæsar Hawkins to be of a semi-malignant nature. Mr. Hawkins believes it to originate in the periosteum of the bone, and that the removal of its entire root is indispensable to the future safety of the affected person, for the accomplishment of which he recommends the employment of the actual cautery, or the application of strong nitric acid.

In preternatural elongation of the *frænum linguæ*, the best mode of proceeding is to seize the frænum with a pair of forceps, and drawing it forwards, to divide it with a common pair of scissors.

REMOVAL OF ENLARGED TONSILS.

Children of a strumous habit are frequently the subject of a chronic enlargement of the tonsils, which interferes greatly with both speech and deglutition. In order to justify their excision, the disease should be thoroughly chronic in character, and free from pain and vascularity. In this condition, these bodies stand out from the surface in the form of two rounded bodies, of a pale color, and marked on the surface by the dilated orifices of their mucous follicles. Sometimes they come into absolute contact, and fill the greater part of the cavity of the isthmus. Extirpation is the surest and most efficient remedy. It is not, however, requisite for the purpose of giving relief from the recurrence of past symptoms, or for the prevention of future increase in size, that the entire body of the gland be removed; a portion only will suffice for both these ends. If any remains of recent inflammation be present, or the surface exhibit in a positive degree the redness and the general tumefaction of recent inflammatory action, the operation should be postponed. This operation is not a painful one, and is usually unattended by bleeding, unless the arch of the palate be much drawn forwards.

For the removal of enlarged tonsils, an ingenious instrument has been invented, called the guillotine, consisting of a flat plate of metal, with an aperture at the further end, through which the tonsil passes, and which is there fixed. A knife connected by a slide is then pressed backwards, and cuts off the protruding part. The objection to this instrument is that it does not leave to the discretion of the operator to determine the quantity of the tonsil he wishes to remove. I prefer a knife resembling Cooper's Hernia knife, with a blunt point and hooked forceps, called a vulsellum. These forceps should be made without a spring in the blades, but with scissor-handles, that some force may be employed to open them if required. If with a spring, no power of expansion can be added beyond that of the spring, which is often insufficient in the mouth of a refractory child. The tonsil of one side being seized by the forceps, is drawn towards the mesial line, and the edge of the knife applied either above or below it. Generally speaking, the incision through the tonsil is made cleaner by dividing from below upwards. Some care is often required to prevent injury to the arches of the palate, and in the division of the gland from above downwards the tongue

is liable to be wounded. I have never known more than one case out of perhaps fifty, in which I have done this operation, where hemorrhage occurred sufficiently great to occasion trouble. If hemorrhage follow, it is obvious that the operation was ill-timed or inadmissible. Still rare cases have occurred in which bleeding has continued to an injurious extent, and in such cases the hemorrhage has been referred to an irregular origin of the tonsillitic artery from the internal carotid trunk.

ON STAPHYLORAPHY, OR VELO-SYNTHESIS.

Infants are occasionally born with cleft palate. This want of development may extend to the bony structure of the maxillary and palate bones, or be confined to that of the velum. The defect becomes apparent on the attempt of the child to suck, which is made with great difficulty, when the want of the continuous membrane permits the fluid to pass into the nose, from which it trickles on to the face.

Before I describe the operation for uniting the opposite sides of the velum and palatine membrane, a brief description of both the anatomy and the physiology of the soft palate will not, I trust, be deemed out of place.

The palate, so called, is divided into the hard and soft. The former is composed of the palatine processes of the superior maxillary and palate bones, uniting along the mesial line, and covered by the palatine membrane, a structure of low organization. The soft palate (the velum pendulum palati) is prolonged backwards from the arch of bone above described, to the extent of about an inch, and is composed of muscles, vessels, nerves, mucous glands, invested by mucous membrane on both its surfaces. The muscles consist of five pairs, two of which, but slightly connected to the palate, descend in the half arches that are lost below in the tongue and pharynx, the palato-glossus (constrictor isthmi faucium), and palato-pharyngeus. The other three are the levator palati, tensor palati (circumflexus), and the levator uvulæ. The levator palati, arising behind from the temporal bone, descends forwards and expands like a fan into each half of the palate. The tensor runs horizontally inwards, nearly along the bony edge of the hard palate, towards its fellow, in the mesial line. The action of the levator is that of raising the palate, and drawing it backwards horizontally

towards the pharynx. That of the tensor, as its name denotes, stretches the palate in the transverse direction, and renders it firm in the act of deglutition.

While at rest, the soft palate falls from the bony ridge to which it is attached, obliquely backwards, in a position intermediate to that into which it may be called by the action of its various muscles, whether during mastication or in deglutition. In the act of mastication, it is drawn downwards by the palato-glossus, till it touches the tongue, and thus forms a back wall to the mouth, protecting the glottis from the sudden escape of any particle of food. In deglutition, the opposite muscles are brought into action, and the levator, more especially, draws the palate upwards and backwards, till, by the advance of the pharynx, the two come into contact, and the cavity of the nose is shut out from the passage thus perfected below it. At the same moment, the tongue, having the morsel of food placed upon it, is closely applied against the concave vault of the hard or bony palate, the firmness of which is prolonged on to the soft palate by the tendinous structure of the tensor palati drawing outwards from the mesial line. The act of deglutition is effected by the pressure exercised by the tongue against, first, the hard, and then the soft palate, fixed by the tensor muscle.

It is difficult to explain, or almost to characterize the troubled and abortive movements that accompany the soft palate, when fissured throughout its length. They certainly cannot be satisfactorily explained on any ordinary principle of muscular action. It would appear as though the combined muscles exercised the inclination to draw the two sides into contact; and, indeed, the two sides do coalesce towards the uvula in some movements, but by what agency I am at a loss to tell. I have observed this phenomenon on several occasions.

The operation for staphyloraphy should never be attempted much before the age of puberty. Unless the patient lend himself entirely to the surgeon, and is fully conscious of the extent of the imperfection, and possess resolution to undergo a tedious, irksome, and painful effort at reparation, the operation should not be attempted. Without the entire consent and co-operation of the patient, the best attempt would prove nugatory, and the failure can only attach discredit both to the operation and the operator, and deter others from availing themselves of the advantages afforded by a successful issue. At the same time, it is very desirable that the operation be

undertaken at as early an age as possible, for the period of growth is that to which we must look for restoring to the muscles their natural, or rather of calling into action their new-born functions. I have undertaken it at fourteen, and so late as forty-three years of age, but with very different results, so far as muscular action is concerned. A perfect state of the patient's health is, of course, indispensable.

For the operation, a good light is essential. The patient should be seated in a chair on a level rather below that of the operator, and the head supported against the chest of an assistant or a nurse. The first step in the operation consists in paring the edges of the fissure. This should be effected with great nicety, and should include the entire skin, beginning at the one-eighth of an inch *higher* than the point of junction, and carried down to the extremity of the uvula, on either side. The edge removed should not be thicker than the one-sixteenth of an inch, but sufficient to expose a raw surface of some line or two in diameter. This is effected by means of a fine scalpel of the smallest size. The difficulty, however, does not rest with the knife, but with the forceps, for as the palate exposes its lateral edge to the instrument, it is difficult to seize it firmly. To remedy this defect, I had an instrument made with two blades of unequal length and mobility, the longer blade being reduced in substance, and moving on to the shorter one at a curved extremity. When the incisions are completed, ten minutes or more should elapse for the bleeding to cease. The threads are to be then introduced, and of these about five is the average number required. This is the main difficulty of the operation; viz., that of returning the needle through the side opposite to that on which the first introduction was made. To overcome this difficulty, many instruments have been invented, both English and French, the principle of which consists in carrying a needle in a curve sufficiently small to return through the opposite half of the palate, at the just distance from the edge of the fissure, and at the same time to present the point directed straight forwards at its first introduction. One thing is quite certain, viz., that, however perfect the instrument may be, it will be unavailable to any good purpose, unless the hand of the operator has acquired by practice a perfect mastery over it. On the dead subject the experiment may be tried, and with some advantage; but the dead body cannot represent living structure. We have no convulsive actions of the tongue, no hemorrhage, no clinging together

and confounding of threads by a glairy saliva, and without these concomitants, we cannot imitate the real operation. The simplest means, perhaps, of passing the thread is by the agency of minute and curved needles, the length of which should not exceed one-third of an inch, and they are held by means of the porte-aiguille. The threads employed should be of two sizes. About two of the larger size may be used towards the middle, at, or about one-third the distance from, each extremity of the incisions; the remainder may be finer, and occupy the centre and the extremities. The distance from the edge at which the needles are introduced should be about that of a line, and the larger one something more, so that we have no fear of laceration in the act of drawing the sides together. It is better to commence above and terminate in the uvula, the opposite sides of which should be connected by one, or perhaps, when usually long, by two ligatures.

In order to obviate the tension consequent on drawing into contact the two opposite sides of the cleft palate, it is necessary to resort to a valuable expedient, first generally adopted by Dieffenbach, of making a lateral incision through the substance of the palate on each side of the central line. These incisions should be made without reference to anatomy, and should involve the entire structure, whether muscles, cellular tissue, or mucous membrane, for all are equally in a state of tension. But if one muscle rather than another be involved in this tension, it is obviously the tensor palati, the fibres of which run transversely inwards, towards the centre. Mr. Fergusson, in a paper published in the "*Medico-Chirurgical Transactions*," has referred this necessity to the action of the levator palati, and no doubt this muscle is involved in common with the tensor in the lateral tension; but it cannot be, anatomically speaking, so closely involved as that muscle, nor can the same relief be afforded by its division as is obtained by a free incision through the body of the palate, as far forwards as the bony arch itself, and this incision would include most especially, or my anatomy is greatly at fault, the tensor palati muscle. I have never divided otherwise than in accordance with the above rules.

When the sides are brought fully and exactly into contact, therefore, a sharp-pointed knife should be passed through the palate on each side, for the purpose of completely relaxing the tension on the wound, two longitudinal incisions being made of about three-quarters of an inch in length, and about half an inch from the mesial

line. These wounds will bleed freely for a few minutes. During the operation, the surface must be repeatedly cleansed, and for this purpose three or four pieces of soft sponge or cotton wool, fixed to a piece of wood, should be used. The sponge, if soft, is preferable, and is frequently required to dislodge the coagulum and the tenacious saliva and mucus, incidental to long exposure of the cavity of the mouth to air, and also to exhaustion. The patient is then placed in bed, usually a good deal exhausted. During the ensuing two days, there is no necessity to debar him from food, which should consist of the strongest soup, with bread or macaroni, milk with isinglass, &c. Inflammation of the palate will almost inevitably follow to a moderate, but not to an injurious extent. In this condition of the surface, a solution of six or eight grains of nitrate of silver to the palate will be found useful in controlling the inflammation. It may be applied daily, and I usually give half an ounce of compound tincture of bark, in each day, at two or three doses. By these means I have seen the entire wound unite by the second intention, as it is called, the process of union not having commenced till the use of the bark on the sixth day. This singular case was that referred to by Mr. Paget, in his "*College Lectures*," for 1849. The sutures should not be removed till they are palpably useless; in other words, until the union is complete and firm, or has entirely failed. I have generally removed them from the tenth to the eighteenth day. If they become a source of irritation, indicated by some increase of pain in swallowing, or by the presence of a red areola around the orifices of the threads, they should be cut out earlier. Should a first attempt partially or entirely fail, there is no objection, on any surgical grounds, to its repetition.

When the operation is finally completed, at the expiration of possibly three weeks or a month, the friends may begin to express disappointment that the articulation of the child, although improved, is still imperfect; and imperfect it will be for months and possibly for years, and not improbably for life. It is the duty of the surgeon to acknowledge this necessary evil before he undertakes the operation. A certain degree of improvement is inevitable, on mechanical grounds, but to represent to the parents of a child that the operation is a certain cure for its congenital defects, is to prove faithless to our trust as medical men, and to commit a breach of those acknowledged laws of honorable dealing, on the precise observance of which alone public confidence can be maintained. The

operation, it must be confessed, is not a cure, and the whole that can be said in its favor is that a cure is now possible, while before the operation it was impossible.

I feel it requisite, in the absence of any published knowledge on the subject, in possession of the public, to say a few words on the after management of these cases. The treatment consists in regulating the actions of one series in muscles, and in exciting to action a second.

The first remark relates to the tongue. The tongue exercises two distinct functions; one relates to deglutition, the second to speech. These functions, when exercised in health, call on the organ for movements totally distinct from each other. In deglutition, as has been already explained, the tongue is engaged in pressing the food against the roof of the mouth and the soft palate, while speech requires its co-operation with the teeth and lips in the enunciation of sounds. There is an exception to this division in pronouncing the letters *d*, *h*, and *l*, and sometimes in sounding which, the tongue touches the roof for an instant, but rather incidentally than as essential to the required sound. In all persons having a defective palate, the movements of the tongue are eccentric, consequent on an instinctive effort to close the opening in the palate by its means, while endeavoring to fill up the interval of the fissure. This action becomes habitual, and is only subverted and corrected by the agency of time. The other series of muscles relate to those of the soft palate, which, having been deprived of antagonism, and partially cut asunder during the operation, are weak and unsteady. The soft palate is paralyzed, it does not respond to the actions either of the tongue or of the agents of respiration or of volition. Its condition corresponds, though in a minor degree, with that of the same organ in stertor; it vibrates under the influence of a current of air. The soft palate as well as the tongue must be educated.

With respect to the tongue, I have seen great advantage obtained from speaking with a pebble in the mouth, or a glass bead, which has been fixed to the lower teeth, or some similar means of fixing it in the base of the mouth. In pronouncing the letters *c*, *s*, and *z*, the tongue is required to regulate the current of air passing through the closed teeth; but the organ is instinctively raised to its old position, and hence the difficulty of these letters. This difficulty is only to be overcome by long and continued exercise. In fact, the advantages derivable from the operation do not hold reference so

much to the soft palate directly, as to the tongue, which by the union of the fissures is released from the abnormal duty of contributing to its closure.

The muscles of the soft palate may be exercised without much difficulty in health. That we possess a voluntary command over them may be inferred from the power exercised in regulating, by their means, the size of the column of air which passes at any given moment through the nose, as in the act of blowing it. In this action the soft palate is drawn backwards to touch the pharynx. Air is forced against it from below, and on the sudden remission of the contact is the force of the current obtained. Children who are the subjects of this deformity should be taught to practice this and similar movements before a glass, with the mouth open. They should be required to read aloud frequently during each day, audibly and very slowly, and as distinctly as possible. I have generally recommended that the child should be placed at the distance of the further end of the room, and be required to speak in a loud tone, that all the defects of speech and difficulty of enunciation should be palpable to itself as well as to others. These difficulties will be chiefly comprised in the three letters I have mentioned, *c*, *s*, and *z*, and are really due to the tongue while holding a false relation to the front teeth, rather than to any want of action of the soft palate itself. This may be understood by observing the different characters of the sound in pronouncing the combination of the letters *sh*, as in the word *she*, and the sound of the *s* employed singly. In the former, which requires the approximation of the tongue to the roof of the mouth, children, after the operation, will pronounce almost perfectly; but directly the tongue is required in the front of the mouth to regulate the column of air passing through the teeth, then the defect becomes palpable, and the articulation imperfect. Perseverance in the endeavor to regulate these actions will succeed in enabling the patient to improve his speech in a very important degree, and to pass current in society without observation.

BRONCHOCELE.

This disease does not frequently admit of relief through the medium of operative surgery. The enlargement of the thyroid body (or gland, as it was formerly called) is so common a malady, and at the same time so little allied to what would bear the definition of

disease, at the same time that the organ itself is, anatomically, so inseparably connected with the complicated structures around, that the practiced operator is very reluctant to resort to the application of the knife for its relief. The question of extirpation of the thyroid body has been mooted, and actually proposed, in cases either of great and injurious enlargement, or of malignant disease. In either case it is, in my opinion, inadmissible. If for enlargement, the condition of the so-called disease would never justify it, unless the four arteries which supply the organ with the pabulum for its increase were cut off without benefit; and even this, or rather these operations, are wisely eschewed by all reflecting surgeons on the ground of their impracticability; and, *à fortiori*, the removal of the body itself must be indeed a difficult undertaking; while, if proposed for malignant disease, it is exceedingly improbable that such disease could be so entirely insulated by the knife as to justify the attempt to encounter so large an operation, and one which would be almost certain to be followed by a fatal result.

While on the subject of tying arteries in the region of the neck, I have referred to the operation for tying the superior thyroid artery, as performed by Sir W. Blizard, by Mr. Earle, and others. It is an operation, the performance of which is perfectly justifiable, and, as I can testify, is attended with marked diminution of the enlarged structure, if this be the object to be attained: but the relations of the inferior thyroid are so much more complicated, and the artery itself lies so deeply imbedded in the structures of the neck, that I conceive its exposure to be almost impossible.

The removal of a portion of the thyroid body appears to me a proposition nearly as preposterous as that of its extirpation, and I can only counsel the young operator to avoid it.

I am inclined to think that simple enlargement of the thyroid body is not so frequent a source of evil, on the ground of its pressure, as many suppose. I am quite aware that difficulty of respiration and of deglutition not very infrequently attends it, and that such symptoms appear to result from the presence of the abnormal structure, which occupies so large a portion of the anterior aspect of the neck; but I cannot forget that this condition of the organ is peculiarly incidental to young women; that the symptoms of inconvenience are very disproportioned to the size; that its attacks are eccentric and uncertain; and that the inconvenience of its presence is chiefly experienced during the catamenial periods. In fact there

is so much of hysteria mixed up with it, that I am myself exceedingly disinclined to countenance any attempt to afford relief by operation; and, assuredly, I have no faith in the proposition that was made, I believe, by Mr. Allan Burns, to divide the fascia covering it.

In cases of great enlargement of the thyroid body, a better, because a simpler, operation may be resorted to which is equally efficient in affording relief and in avoiding danger. In the examples of enormous growth, we find, by dissection, the mass to be composed of dilated cells, containing serum to the extent of from half an ounce to six or seven drachms. These cells may be evacuated by a trocar, with great temporary relief. I do not pretend to much experience in this treatment; but I have successfully experimented on this principle of treatment in more than a single case. In the course of last year I saw, with Mr. Lobb, a lady who had one of the largest bronchoceles I have ever seen in England. All ordinary treatment failed to afford her relief from its most inconvenient weight. On examining it carefully, I detected the situation of various of the cysts of which it was composed. Into one of these I introduced a small hydrocele trocar, and removed seven drachms of bloody serum. The wound was healed. The fluid again collected, and the cyst was repunctured. We then attacked two or three of the others, and, by repetition, reduced permanently the bulk of the entire tumors; for, after repeated puncture, the cysts became reduced in size, and the relief was so great as to render the lady perfectly content with her condition. These operations have now been performed fifteen months.

In another case, I punctured a cyst of the thyroid body several years ago without danger or difficulty, but with great temporary benefit. I lost sight of the case, however, and am unable to give the result.

The application of a seton thread is so great a resource in many kinds of serous cysts, whether containing modifications of salivary fluid or albumen, whether in bursæ, ranula, or hydrocele, that one sees no reason why this remedy may not be employed with equal benefit in the cases in question. If a cyst be emptied with a trocar, and its size calculated by the quantity that escapes from it, there could be no difficulty in passing a thread into and through the cavity by means of a much-curved needle. The thread should be fine, as should the needle employed for its introduction, of substance, indeed, sufficient only to insure safety. The effect should

be watched with care, and removed on the occurrence of any positive pain.

In these enlargements of the thyroid body, the sternoid muscles which cover it are so attenuated by the long-continued pressure, that a puncture through them is an unimportant consideration in the proposition. The carotid arteries lie quite at the side and behind; and if those cysts only be selected for puncture that are clearly perceptible from the front surface, and the circle formed by the ligature be not greater than three-quarters of an inch, one does not see from what source evil could arise, so far as the operation itself is concerned.

ON TRACHEOTOMY.

Surgeons are occasionally required to make an artificial opening into the windpipe, either with a view to obviate the fatal consequence of constriction of the canal, for the purpose of attempting the removal of a foreign body that has accidentally entered it, or for that of inflating the lungs in persons drowned. The extreme irritability of this canal, and its high degree of vitality, intimately connected as it is with the indispensability of its healthy functions to life, now disturbed either by disease or by the presence of a foreign body, renders this operation one of peculiar delicacy, and of some difficulty and danger. Tracheotomy is required in cases of disease of the larynx, the effect of which is to contract the canal. The seat of such disease is, of course, the glottis, around the orifice of which the membrane is thickened by inflammation and its products, as the deposition of lymph in the form of an adventitious membrane. The contraction of the canal thus formed, however, bears no comparison to the difficulty caused in the respiration, which is always greatly affected in a degree disproportioned to the encroachment of the tube, thus indicating the great importance of this structure in the economy of the living body, and on this principle we explain the irregular and spasmodic nature of the symptoms which characterize its diseases.

The disease for which the operation is required is, for the most part, laryngitis, or inflammation of the larynx, attended by thickening of the membrane covering the chordæ vocales, whether affected primarily or by extension from the fauces or tonsils. We do not pretend to be governed by the presence of this or that form of

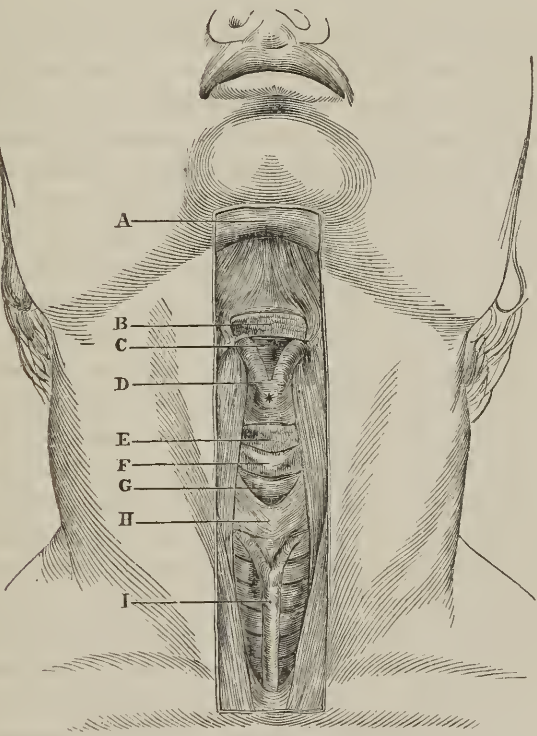
disease, but by the pressure of symptoms, which, if imminent, demand artificial opening, to whatever class they belong, or in whatever region they originate. In order to justify the operation, the symptoms must be clearly defined, and the case thoroughly understood by the operator, who may be supposed to undertake it at the request of a physician or general practitioner. But the necessity of the operation should be rendered obvious, in order that the two authorities should act in conjunction. These symptoms are, great dyspnœa, threatening suffocation, loss of voice; the act of inspiration is short and made with a painful effort, and often productive of a whistling sound in the larynx; lividity of the skin, either of the face or extremities; respiratory murmur imperfectly heard over the surface of each lung. The symptoms may be distinguished from those of fluid in the pleural cavity, by the disease being obviously referable to a point common to the two sides of the chest. The lungs equally participate in the difficulty consequent on an obstruction common to the two. There is no evidence of disease referred to the chest, but there is evidence of that of the larynx or trachea, indicated by local pain, with more or less of swelling, and tenderness on pressure. In laryngitis the patient is raised in bed with his head drawn forwards, while in empyema the body is often inclined over to the diseased side.

With such symptoms, and with threatening suffocation, the surgeon has no alternative but that of operation; but before proceeding to this crisis, he should survey the neck, and call to his recollection the relations of the various structures occupying its central line, and proceed to select that situation in which the opening may be made with the least danger; and this selection is a very important consideration. In order to assist in this decision, I have had the following sketch of the middle line of the neck made.

Any incision made into the air-tube above, or through the cricoid cartilage, would constitute the operation of laryngotomy. The line drawn across the thyroid cartilage indicates the attachment of the chordæ vocales, and the * above it that of the epiglottis. Now the distance between the point of connection of the chordæ vocales, and the crico-thyroid membrane, which is the only membranous part through which an opening can be made below the cords, is not more than one-third of an inch; and supposing the disease to be, as usually found, occupying the glottis or the opening between the cords, it is not unreasonable to suppose that inflammation and

thickening will advance even lower than the point indicated, and that the consequences of the operation may extend to them from the close proximity of the opening made into the tube and the cords above. In order to avoid this evil, the part selected has usually been that below the isthmus of the thyroid body; but to this locality there are abundant objections. In the first place the trachea is placed very deeply in the neck, increasing, however, as it descends. Immediately above the sternum, the air-tube lies at a distance of more than one inch from the surface, and this is a great depth to

Fig. 67.



A. Base of the jaw.—B. Os hyoides.—C. Thyro-hyoid ligament.—D. Thyroid cartilage.—E. Crico-thyroid ligament.—F. Cricoid cartilage.—G. First ring of trachea.—H. Isthmus of thyroid body.—I. Inferior thyroid vein.—* Insertion of epiglottis—attachment of chordæ vocales.

dissect upon in so critical a region, even under the guarantee of the soundest anatomical knowledge. Another difficulty is founded on the very great irregularity of the vessels in this region descending on the trachea. It must be recollected that the two sterno-thyroid

muscles are placed side by side, and closely in contact, and that although it may not be difficult to hit the precise line of junction in the dead subject, it is exceedingly difficult to effect it in the living, and having once lost the mesial line, all is uncertainty onwards in the dissection. The vessels underneath the sterno-thyroid consist of a large venous trunk of great size, the inferior thyroid, or a congeries of smaller veins which from their proximity to the heart bleed very freely, and fill the wound with blood, which it is, perhaps, more indispensable to the progress of the operation to be kept dry and clean, than any wound made in operative surgery, for the blood, trickling into the trachea when opened, would aggravate the patient's suffering, and, if profuse, might prove even dangerous. Besides these vessels, we have occasionally a middle thyroid artery, ascending on the trachea from the arch of the aorta. These obstacles to the progress of the operation render it tedious and often dangerous; and I remember once to have witnessed the operation arrested, under the hand of a surgeon of some experience, in consequence of the number and size of the veins occupying the front of the tube. Indeed it is very rare that they are entirely absent. The exposure of the surface of the trachea above the thyroid isthmus has not these objections. It will be observed that a space is there left uncovered by muscle or gland, of about a quarter of an inch in length. This part of the air-tube is nearer to the surface, and though not destitute of vessels, is comparatively free from them. An artery of some size, often, though not generally, coasts along and in contact with the upper border of the isthmus, crossing the trachea. This is the point that, in my opinion, should be selected for the operation of tracheotomy. It is true that its size is limited, scarcely admitting the passage of the curved trocar; but to obviate this disadvantage, the isthmus being connected to the trachea by cellular tissue only, may be detached by a blunt hook, and drawn forcibly downwards; indeed, if necessary, and in the absence of the transverse inosculating branch of the superior thyroid arteries, the isthmus may be divided along the mesial line, and without bleeding, consequent on the absence of the inosculating branches of the two lobes. I have been troubled, even in this situation, by the presence of veins; but, if present, they are small in comparison with the venous trunks covering the trachea below the isthmus. Every difficulty in the progress of the operation for tracheotomy, when called for by disease, should be avoided, on account of the incon-

venient and irksome position of the surgeon, caused by that of the patient, who resists every attempt to place his head in a favorable attitude for the purpose, with the instinctive object of preventing strangulation.

I consider that this situation should be selected, also, whenever it is deemed necessary to perform the operation of tracheotomy, for the purpose of inflating the lungs in drowned persons; but, on other occasions, and in the absence of disease, there is no objection to the higher operation, or that of laryngotomy. When an opening is made for the purpose of facilitating the removal of foreign bodies by the introduction of an instrument down the tube, the lower operation, or that above the sternum, may promise a better chance of success; but as I have never known any advantage to arise from this attempt, but rather an aggravation of the patient's sufferings, so the operation, when performed with this view, does not appear to me to justify a deviation from the recommendation above given.

Previous to the operation, the surgeon should make a careful examination of the mesial line of the neck, and mark in dotted lines with ink the point of the canal which he proposes to open. The patient is then placed in such a position in bed as will afford the operator a perfect command of the neck, so far as this is compatible with the respiration of the patient. But this function being deranged, the best position, viz., that of the head thrown sufficiently backwards, is rendered very painful, and is often impossible to be retained for any length of time. Between the necessities of the patient and the requirements of the surgeon, the best compromise must be made. An incision of about an inch and a half in length is made in the mesial line, beginning about the middle of the thyroid cartilage, and continued downwards, and the parts rapidly dissected till the cricoid cartilage is exposed. The examination of the trachea below should be made with more caution, and the parts being exposed, the operator will be enabled to judge whether he has space sufficient to introduce the tube above the isthmus. If not, this part of the thyroid body may be drawn downwards with a blunt hook. Space being thus obtained, a fine knife should be passed into the trachea, and a circular piece cut out, great care being taken to hold it firm while cutting. The relief to the respiration will be instantaneous. The curved chain trocar, which was invented by the late Mr. John Wood, a very promising young surgeon, is often employed. I have used it on more than one occasion; but the objection to it is

founded on the difficulty of its first introduction; and, although the presence of a canula in the wound answers two important indications—first, of preventing the entrance of blood into the tube, and, secondly, that it fully retains the opening—yet I am inclined to think, that when we have no hemorrhage to contend against, and the disease being of recent existence, leads to the probability of early recovery, it is better to divest the trachea of the foreign body altogether, and to rely on the removal of a circular portion of the tube. The introduction, or even the presence of the canula, is generally a source of great irritation and coughing, much of which may be avoided by leaving the opening unmolested. The accompanying sketch represents an instrument which I think preferable either to

Fig. 68.

the knife or to the chain trocar. It consists of a canula with a cutting edge, through which passes a trocar cylinder, terminating not in a cutting point, but in a small hook. The two are connected by a well-made screw, by which the canula revolves upon the trocar within it. The screw point projects a quarter of an inch beyond the cutting edge of the canula. The instrument is applied by seizing the portion of the trachea to be removed with the hook; the canula is then screwed down, with its cutting-edge on the rings of the tube,

and the centre-piece drawn out. The canula may be retained or not. This instrument is the invention of Dr. Marshall Hall.

Great after attention is required by the patient. The attendants should be instructed in the best mode of keeping the wound clear of mucus, which tends frequently to obstruct the current of air through it.

The lower operation, performed in the supra-sternal fossa, has no peculiarity beyond the lower incision, and the great care required in dissecting the surface of the trachea. The greater depth of the wound will prolong the operation to double the length of time required for the other. Silver knives should be used in dissecting.

Laryngotomy.—In opening the larynx, the crico-thyroid ligament is divided, or cut away. The external incision should be commenced at the highest part of the thyroid cartilage, and continued down along the mesial line, and the dissection carried on to the membrane. I see no reason why the instrument of Dr. Hall should not be applicable to its removal, although the membrane is more resisting and unsteady than the rings of the trachea.

CHAPTER XIV.

OPERATIONS ON THE CHEST AND ABDOMEN.

Paracentesis Thoracis.—The cavity of the pleura, consequent on an attack of pleurisy, may become distended with fluid, which may exercise a very injurious degree of pressure on the body of the lung, and materially influence the position of the heart. Under these circumstances, a surgeon is occasionally called on to relieve the patient by evacuating the fluid. As the discredit of failure would be equally shared by the adviser and the performer, it is the duty of the surgeon to ascertain for himself the necessity of the operation before he undertakes it. The symptoms justifying the resort to puncture of the cavity of the chest are obvious and severe dyspnœa, threatening suffocation, lividity of the skin, whether of the face or extremities, puerile respiration on the sound side, cessation of vocal vibration, no vocal resonance. The entire act of inspiration is short, and marked by great effort, and the movements almost imperceptible. The past history points to pleuritis as the cause. The person of the patient is inclined over to the diseased side in order to prevent the weight of the fluid oppressing the opposite lung. On examining the chest, the affected side is found larger by measurement than the opposite; the intercostal spaces are dilated; pressure on them by the fingers produces an elastic recoil; the entire surface is dull on percussion; respiratory sound inaudible; the heart is forced from its position, and, in cases of disease of the left side, may pulsate behind the sternum, or even to its right side, while in that of the right, it may present five, six, or seven inches from the sternum. The prognosis from the operation depends on the more or less active, and also on the more or less protracted, nature of the disease. If the disease be advancing, it will be unfavorable; if chronic, and leading to the probability that the pleura is so thickened as to preclude the hope of a renewed expansion of the lung on the removal of

the fluid, it will also be unfavorable. The symptoms, however, threaten immediate loss of life, and we puncture the chest.

It is always desirable to distinguish empyema from hydrothorax. In purulent formation, we have usually rigors and hectic fever, and generally more constitutional disturbance than in the more chronic form of disease. We cannot hope for the absorption of the pus of empyema, which is only to be got rid of by puncture, whereas the whey-like fluid or serum of hydrothorax is frequently absorbed under appropriate treatment; therefore, the operation of paracentesis is more directly indicated in the one disease than in the other.

The objection to a puncture forwards is found in the gravitation of the fluid backwards in the position in which patients usually lie. The objection to that backwards, towards the spine, consists in the narrowness of the intercostal spaces, the larger size of the intercostal arteries, and the greater thickness of the muscular investment of the chest. One rule, however, is yet more important, viz., to select a point towards the centre of the fluid collected, and inasmuch as the objection on the ground of gravitation may be met by a corresponding position of the patient, so it is better to err by puncture in the direction forwards than backwards, unless, indeed, it is intended to retain the opening by the presence of a hollow tube in the wound.

The instrument used should be a flat trocar, of a size intermediate between those employed in hydrocele and ascites. There is no necessity for the previous introduction of a grooved needle. The trocar should be introduced, without previous incision by the knife, in the centre between the ribs, by drawing aside the skin, and making a valvular opening as low down in the chest as possible; but whether between the fifth and sixth, or between the sixth and seventh, or still lower, does not, so far as I know, admit of any imperative rule; unless, indeed, when in empyema the matter points on the surface, I believe it would be equally safe between the ninth and tenth, if the puncture be made far backwards. The trunk of the intercostal artery runs along the lower edge of the upper, and a considerable branch along the upper edge of the rib below. When the fluid is nearly evacuated, or at least when it ceases to flow spontaneously, except by requiring an occasional effort at full inspiration, the canula may be withdrawn and the wound healed. It is of great importance to prevent the ingress of air into the cavity during the operation, and for this purpose a useful instrument has been invented

by which the fluid is drawn off under water, and thus the liability to this evil is entirely prevented. It is better to repeat the puncture when necessary, than to retain a gum catheter in the wound—which practice I have on some occasions adopted.

As to the quantity or proportion of the fluid to be evacuated at one time, it would certainly appear on all accounts desirable that a portion only be removed at a time, allowing time for the lung to expand, for, as Dr. Williams observes, in the article on Pleurisy, in the "*Practical Medicine*," something must occupy the space of the fluid removed, and it is not probable that the lung is in a condition to expand sufficiently to fill it. Moreover, in the case of hydrothorax by the removal of a portion of the containing fluid, we place the remaining quantity in a better condition for absorption. Dr. Williams has suggested the propriety of injecting warm boiled water into the cavity, to displace and dilute the pus in case of necessity, and would even justify medicated injections.

A curious case occurred in St. Bartholomew's Hospital, in which, with well-marked symptoms, Mr. Stanley twice failed to obtain fluid after puncture. On examination, it appeared that the cause of the difficulty arose from the presence of a false membrane that was on each occasion pushed before the trocar.

To the above I may add some of the physical signs of pneumothorax, which consists in peculiar resonance on percussion, with metallic tinkling, when accompanied with fluid, loss of voice and breath sound, or amphoric resonance of voice, if the layer of air be not very thick, and limited movements of respiration. There is usually more or less fluid in the cavity, the line of which may be ascertained by percussion. It is better to tap, so as to evacuate the fluid and air at the same time. Much benefit is derived from rolling the chest tolerably tightly, both during and after the operation, with an elastic bandage, as in the case of the same operation on the abdomen, and more especially when the collection of fluid has been large and the ribs distended.

OPERATION ON THE ABDOMINAL PARIETES.

Paracentesis Abdominis. — This operation is required for the removal of fluid, collected either in the peritoneum or in the ovary, constituting either ascites or ovarian dropsy. In operating for ovarian dropsy, it is always desirable to ascertain by percussion, &c.,

the degree of density of the contained fluid. The degree of fluidity of the contents of the sac may be ascertained with some exactness by percussion. If consisting of pure serum, the slightest concussion of the finger is perceptible on the opposite side of the abdomen. By careful percussion we glean some knowledge of the number and general size of the cysts, supposing several to exist.

The, size of the trocar should be moderate. There is no advantage to be derived from the employment of a very large instrument. A hydrocele trocar will often suffice; and in some cases it is even advantageous to employ the finest instrument, allowing the fluid to drain off gradually. Previous to the operation, an elastic belt, perforated in front by a hole, should be fixed round the abdomen, and attached by buckles behind, so that it may be tightened during the operation, if requisite. The trocar may be introduced from one to three inches below the umbilicus, and if done rapidly, is almost a painless operation.

Abscess in the Parietes of the Abdomen.—Abscess in the subcutaneous tissue and fat of the abdominal wall, though not common, is more frequently met with than the same disease occurring between the muscles, or than that of abscess in the sheath of the rectus muscle, which is an exceedingly rare disease. When situated over or in the neighborhood of the liver, it is often mistaken for abscess in the organ itself.

Among the remarkable errors that pervade the mind of professional men, having rare access to the means of recalling anatomical details to their recollection, none is more striking, and among errors, more universal, than ignorance of the situation and relations of the liver. It is not uncommon for a medical man to place his hands on the abdomen, midway between the margin of the ribs and Poupart's ligament, and declare that the liver is enlarged, or indurated, or otherwise diseased. I venture to assert that it is a difficult organ to feel at all. The liver, unless enlarged, and its increase of bulk is rare, does not descend more than an inch below the margin of the ribs, and is really not perceptible on pressure, consequent on the tension of the muscles connected with the chest.

Abscess of the walls in this region may be distinguished from abscess of the liver, by being more diffused, by having more thickening around it, the cellular thickening of the wall itself, by the absence of much constitutional irritation, always present in this description of disease of the liver. The nucleus of the diseased action appears,

as it really is, near the surface, and the skin exhibits a larger areola of inflammation as the disease is matured. Besides which, on examination, it will be seen that the abscess does not occupy the true locality for hepatic disease. A young medical student was under my care with abscess below the margin of the ribs, on the right side. His father was a medical man, and by whom he was sent up to town to be treated for hepatic abscess. He had also, at the same time, a positive attack of jaundice. Notwithstanding the jaundice, I punctured the abscess and he recovered. In all such abscesses, if slow in advancing, I am in the habit of giving bark in considerable doses. As soon as suppuration is established, they should be opened by a free incision, if the thickening be great around them.

CHAPTER XV.

ON HERNIA.

OPERATING THEATRE THE BEST SCHOOL.—DEFINITION.—CAUSES.—SYMPTOMS.—ANATOMY OF INGUINAL HERNIA.—ANATOMY OF DIRECT HERNIA.—OPERATION.—QUESTION OF DIVISION OF SAC.—AFTER TREATMENT.—INFLAMMATION, TRUE AND FALSE.—FEMORAL HERNIA.—OPERATION.—UMBILICAL HERNIA.—OPERATION.

THE operating theatre of a hospital is the only school for the acquisition of a complete and practical knowledge of hernia. Indispensable as may be the cultivation of anatomy to entitle a surgeon to rank in the operative department of our art, we find, perhaps, no branch of the subject in which the acquirement of the dissecting-room leaves the real necessities of the practical surgeon so unsatisfied as that of hernia, or in which the recollections or associations of that theatre of study can so little be brought to bear upon the almost infinite varieties of form and structure, that present themselves to the operator throughout a long career of hospital practice.

And yet, without the education of the dissecting room, without the possession of the knowledge which practical manipulation alone can give us, who will venture to operate for hernia? If the science of anatomy does not reach the actual level of our wants, and in reference to the subject of hernia it never can, we must not forget that to this study we are indebted for that knowledge which alone can form a safe and efficient foundation for the subsequent acquisition of practical experience.

I do not, by such remarks, desire to depreciate the value of anatomical knowledge in reference to the subject before us, but merely to express my conviction, that no man is less competent to the exigencies of the operating table, when called upon to dissect down to the seat of stricture in a case of strangulated hernia, than he whose

functions have been restricted to the duties of the dissecting-room.

If we divide an operation for strangulated hernia into three distinct stages, and give to the first of these the dissection requisite to expose the seat of stricture; to the second, the division of the stricture itself; and to the third, the replacement of the intestine or other part protruded, it must be acknowledged that we owe to anatomy nearly all the information by which we are enabled to remove the greatest difficulty in our path with safety to our patient.

In reference to the subject of hernia, it is necessary to distinguish between a knowledge of the parts in which hernia occurs, and that of the same parts affected with hernia, than which no two regions can be more dissimilar. And yet they have characters and relations in common. It is just this common property of the two conditions which is valuable to the surgeon, and without a familiarity with which, the operation for strangulated hernia has always more or less of danger attached to it. For example, no hernia, however large, can alter the relations of the epigastric artery to the internal ring, in inguinal hernia, or that of Gimbernat's ligament, or the femoral vein, to femoral hernia. These are salient points from which we start—permanent beacons for our guidance in all examples of inguinal or femoral hernia. But, on the other hand, when we are told by the anatomist that, in its descent from the interior of the abdomen into the scrotum, the spermatic cord receives certain coverings or investments from the layers constituting the abdominal parietes, and that each of these investments may be known by certain definite characters, we shall look in vain for their realization, either in quality or in number, because the structures have undergone so complete a change of texture that no one can be identified as bearing out the description of the anatomist. To a certain point, therefore, we must rely on anatomical knowledge; beyond this, it will only lead us into danger.

Before I proceed to describe the various operations required for the relief of strangulated hernia, I propose to make some preliminary remarks on the nature and cause of the protrusion which has received this name.

The greater liability to abdominal than thoracic hernia is due to two causes: first, because the quantity of the contents of the abdomen varies at different periods, not only of life, but of each day; a different relation exists between these contents and the containing

walls, and these relations are subject to pressure, both forcible and spasmodic, from the muscular structure of the walls acting on four out of six surfaces at the same time. Second, because the integrity of the walls is impaired, or, at least, rendered imperfect, by the necessary transmission through them of certain vessels, and other structures required for the supply of the economy beyond. These two conditions operate as the most remote of the causes to which hernia may be attributed, and are incidental to the natural structure.

Firm pressure is made on the movable contents of the cavity in all muscular efforts of the body, by the conjoint and harmonious antagonism of the diaphragm and abdominal muscles forming its upper point and lateral boundaries. Either the excess or the too sudden operation of this pressure protrudes a portion of the contents through the inguinal or femoral rings, or at any other defective point of the walls, and the hernia is established. But this protrusion is readily returned, and again descends on the recurrence of the cause. If, however, on the occurrence of any exertion requiring especial force of contraction of the abdominal muscles, a larger portion of intestine than usual is forced from the cavity, the hitherto successful efforts at its restoration fail, and pain follows. This difficulty is not referable to the increased contraction of the opening through which the intestine has passed, but on the increased quantity of the substance passing, and this increased quantity exercises a greater than ordinary pressure on the surface of the ring. The consequence of such pressure is, alteration of structure in the protruded parts, the venous system of which being obstructed, the arteries carry the material for effusion into their cellular structure, and the whole protrusion increases in size. *A hernia is always the cause of its own strangulation*, unless the aperture by which it escapes from the abdomen consists of muscular fibres so arranged as to be able to contract around it. In the case of diaphragmatic hernia, these two causes operate conjointly, but in all ordinary forms of this disease the ring is passive and not active in its relation to the proximate cause, and neither in the inguinal, femoral, nor umbilical forms of hernia do we find muscular action otherwise than very remotely concerned in the causes of strangulation. In the disease known under the name of hernia cerebri, the ring is bony, and here strangulation occurs on a like principle, viz., the same swelling of the protruded parts that can alone explain the nature of abdominal strangulation. Indeed we find no muscular fibres

competent to contract on the ring in either of the three localities in which hernia ordinarily occurs. And the occurrence of ventral hernia, in which the contents escape through an aperture formed in the abdominal muscles themselves, is hardly an exception to this law, because there is usually a deficiency of muscular fibres at the part to which the existence of hernia may be referred. If we could imagine a portion of intestine to escape through an opening involving each of the three layers of these muscles, and exercising an active contraction on the protrusion, we should have a condition of parts essentially different from that which commonly attends the disease when occurring in the ordinary situations. In truth, this antiquated doctrine, which has too long for the welfare of humanity referred the cause of strangulated hernia to spasm of the muscles, is almost exploded, and with it the numerous class of supposed remedies attendant in its train.

Symptoms of Strangulated Hernia.—First, a tumor at the situation of a natural opening, inguinal, femoral, or umbilical; if not of recent occurrence, at least of greater than usual magnitude. Second, the patient will generally himself date it to some hour, or from some occurrence, since which he has suffered greater pain or inconvenience than usual. Third, a sense of local tension. Fourth, a drawing or dragging sensation, extending upwards, towards the back of the abdomen, where the intestine or omentum is naturally fixed. Fifth, nausea in the earlier, leading to vomiting in the later, stages. With regard, however, to this symptom, I may observe that sickness in the early stage of strangulation is almost exclusively confined to that of the small intestines. Sixth, constipation of the bowels from obstruction to the tube of the intestine.

With respect to the first of these symptoms, the tumor may be of any form, or of any size, embracing all magnitudes from that of a hazel-nut to that in which two-thirds of the entire mass of intestine is pushed beyond the walls of the cavity. It is in the lesser degrees of the disease that the nicer discrimination is demanded by the surgeon, those cases of recent occurrence in early manhood, which are the product of great and sudden muscular effort, that are perhaps more dangerous in their character and demand more promptness in their treatment. In the case of inguinal hernia of recent occurrence, a small tumor may have escaped from the abdomen, without having made its appearance in front of the walls, and is, in fact, compressed between them at some distance from the surface. The

tumor, under these circumstances, is scarcely apparent to the eye, and presents little more than a mere fullness along the line of the inguinal canal, and only detectable by a comparison with the same region of the opposite side. These are cases of real difficulty, and which require the eye and the judgment of the experienced surgeon. The general symptoms should be weighed with all nicety. Supposing the occurrence of the disease recent, we fail in the resource of one most important symptom, viz., constipation; or indeed temporary constipation may attend the existence of other painful diseases of the groin besides hernia. Still, if the swelling be positive, however small and difficult of detection, and the other symptoms bear out the evidence of hernia, we are compelled to operate.

Several of such cases have occurred to me, as well as to others, presenting difficulties, which can only be met by the application of a defined principle of action. It would be better to cut down unnecessarily on ten tumors bearing the evidence of hernia, than to omit to bring one true hernial tumor to the test of the knife. For it must be recollected, that the operation suggested is not the operation for strangulated hernia, but merely an exploration preparatory, if necessary, to the operation itself. It may require but a division of the integuments and fascia, till, on exposing the disease, we possibly exhibit an enlarged gland, and the operation is concluded.

Such a case occurred to me, during the course of last summer, in St. Bartholomew's Hospital. A man was brought in having symptoms of strangulation, with a tumor in the groin. My colleagues and myself were unanimous in our opinion of the existence of hernia. In the absence of Mr. Lawrence, who had, however, seen the case, and recommended the operation, the duty devolved on me. I exposed the tumor, which proved to be an absorbed gland. This man had local pain, sickness, and constipation.

In reference to the question of form, although we have no positive assumption to rest upon, for the form of the tumor must hold, more or less, a relation to its size, yet the variation in form is less than in that of the other quality referred to. In hernia of the canal, the figure of the tumor compressed by the aponeurosis of the external oblique, must be obtuse and ill-defined, but its depth will, in some measure, point to its nature, inasmuch as any other disease in the canal is of far more rare occurrence than hernia.

Any form of hernial tumor, whether oblique or direct, presenting

below the external ring, being compressed by the pillar of that opening, will necessarily be more or less constricted by them, especially in the early stages of the disease. From this part downwards, therefore, the tumor assumes an enlongated form, however great its magnitude.

The form of a femoral hernia is less definite than the inguinal variety. It is said to extend across the thigh in the transverse direction. This is by no means a general law, nor is it even common; it is only occasional; and still less rarely is it pushed upwards fairly over Poupart's ligament, as is frequently described. It is, however, often somewhat longer in the transverse than in the longitudinal direction, and by this sign alone it may be occasionally distinguished from inguinal hernia. Umbilical hernia is too definite in its characters to render description requisite.

The sensation of dragging from the back is not the attendant on all forms of hernia. It is caused by the tension of the mesentery or mesocolon, which are forced down with the intestine, and attached by the upper extremity to the region of the lumbar vertebræ. In early or recent hernia, this tension is inconsiderable, consequent on the limited descent of the intestine, and is only well marked in those forms of the disease in which the descent is large in volume; then this symptom becomes very prominent.

With respect to the question of constipation, the discharge of the contents of the large intestine below it is, of course, not incompatible with its presence. I have known this discharge in a case of hernia, to be very copious, sufficiently so to have misled for the time the judgment of the most experienced.

Most of the above indications are considerably modified in the case of the descent and retention of omentum alone. The general sense of uneasiness is less marked, sickness more remote, and pain more obtuse. But the constipation may be as complete as in the case of intestinal hernia.

I believe it may be asserted, without fear of contradiction, that the danger attendant on the operation for strangulated hernia is nearly in proportion to the period of the strangulation. Within the last quarter of a century, the treatment of that disease has undergone a considerable improvement, founded on an advanced pathology. Within my own recollection, many hours, even a day or more, were allowed to elapse, for the purpose of bringing into action many worthless remedies that were inoperative to any purpose but that of re-

ducing the small chance of the patient's recovery, by wasting the precious hours during which the operation might have been undertaken with a prospect of success. The profession had a routine of remedies which were resorted to in a given order of succession, and until they were exhausted, it was not deemed right to have recourse to the only remedy that could be available to a successful result. The taxis, warm bath, taxis repeated, cold affusion, the local application of ice, taxis repeated, the tobacco enema, and, finally, more taxis, and then the operation. Thus twelve hours were wasted in the employment of remedies infinitely worse than merely useless, with every hour increasing the danger from the advance of inflammation of the intestines and peritoneum.

The taxis is an obscure word, derived from the Greek word, to "put in order," but conventionally signifies to knead, thrust, or pummel with the hand or fist; and most vigorously was the principle carried into execution. During the twelve hours of treatment prior to the operation, possibly one full hour was devoted to the endeavor to disorganize the delicate textures within the sac, and certainly the occasional recoveries after the operation testify that it was not invariably successful. The term, which is associated with the above practice, is nearly as obsolete as the practice itself. The attempt to return the intestine should, doubtless, be efficiently made by the hand of the surgeon, but employed with all gentleness. Pain is inevitable; but there is a manner of giving pain, when necessary, that at least renders it bearable by the patient.

It often happens that the surgeon can return the contents of the sac, when the patient cannot or will not venture to make the attempt; but I am not aware that what one surgeon has failed in, by the employment of judiciously applied pressure, another surgeon can effect; while I am quite sure that every succeeding attempt that is unsuccessful adds to the patient's danger. In order to apply this pressure by the hand with the best effect, the tumor, if in the scrotum, should be raised on the hand and moved circularly in all directions, and a piece of the tumor pinched up, so as to act on the contents without forcing the mass against the ring. Occasionally success will attend the sudden remission of pressure on the ring, while the tumor is compressed by the hand below. An old practice prevailed in the last century, and recommended by Winslow, of placing the patient with inguinal hernia, on his knees, and leaning forward, while the effort at reduction by the hand was being made, and the position is

not a bad one. I have myself adopted a rule for many years, not to attempt reduction by any persistent effort, after having ascertained that a previous attempt has been judiciously made by a competent man. Every half hour increases the difficulty, and its repetition is almost certain to prove nugatory.

After the attempt to return the intestine by the hand, a warm bath may be resorted to; and before the patient's removal from which, rather from the advantage of his position, the effort may again be made with the hand. The length of time awarded to these agents will greatly depend on the urgency of the symptoms. If the hernia be of recent occurrence, the attempt will be painful, and the symptoms oppressive to the system. The presence of local pain, of nausea, or vomiting, if his features betoken suffering or prostration, if he shrink from the contact of the hand, or betray restlessness and discomfort, the sooner the operation be performed, the greater his chance of recovery. If, on the other hand, the pain be moderate, if he bear the pressure of the hand without shrinking, if without nausea or anxiety of countenance, the operation may be postponed for a few hours, and renewed efforts may be made to replace the intestine. But these efforts can be but a repetition of the former. Six to eight hours from the date of strangulation is perhaps the longest time allowable for the postponement of any operation for hernia.

In the attempt to reduce a large umbilical hernia, I have occasionally succeeded by raising the whole tumor in my two hands, and shaking it with some violence; and even this practice is not so injurious as the kneading process adopted by the old school of surgeons.

With respect to the application of cold, I am inclined to think it a more efficient remedy than the warm bath; but it has been prescribed too late in order of application to be available; yet I have seen benefit derived from its employment externally, and also from its copious injection into the large intestine.

The tobacco enema is deservedly exploded by all good surgeons of the present day.

In addition to the above remedies, the old surgeons employed drastic purgatives by the mouth. The object, one should presume, was the endeavor to drag up the bowel from the sac by the mechanical influence of the medicine on the intestine. I have never seen the

smallest benefit to arise from their administration, and on every principle should strictly abjure their employment.

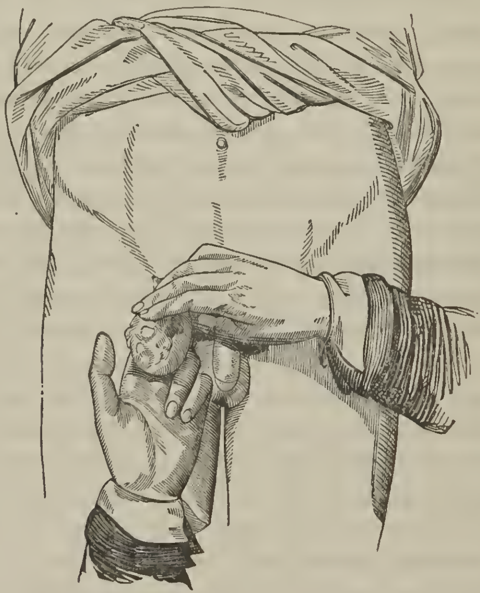
When these agents fail to effect a return of the intestine into the cavity of the abdomen, we have no alternative but the knife. The immediate object of the operation is that of dividing the stricture, to employ again a term that is not always applicable, for frequently there is, correctly speaking, no stricture. It should rather be described as that of enlarging the opening through which the unusually large mass of intestine has escaped.

To effect this object, the parts must be divided from the surface down to the stricture, in succession. This is an act of deliberate dissection. The external incision should be made in the axis of the tumor, and of sufficient length to command the parts within with facility, but still its dimensions should be moderate. There can be no necessity for carrying the incision along the whole length of the tumor, if large, when our operation concerns the neck alone.

Whatever number of laminæ present themselves, they are to be divided, and here we observe the incompetency of anatomy to teach us. In consequence of the elongation of the parts from the internal pressure of the intestine, the structures become laminated to a remarkable degree; as many as six or eight layers of fibrous tissue requiring the introduction of the director, or at least division by the knife. By proceeding slowly through these various coverings, we reach the sac of the peritoneum. Sometimes the sac is drawn so tightly over the contents as to be separated from them with difficulty. We select for this purpose the lower part, which is usually somewhat distended by gravitating fluid, and here it may be opened without danger; or, if the tumor be not sufficiently exposed in this situation, it is better to employ a tenaculum, and raise it from the intestine on the point of the instrument, through which a small opening is made with the knife, and enlarged along its length on a director. The contents of the sac are then exposed, consisting usually of both intestine and omentum, and it is better to pass the eye over the mass when somewhat separated and laid out. These parts should be slightly drawn downwards, for the purpose of easing the ring while the stricture is divided. Under no circumstances in surgery with which I am familiar, is greater gentleness of manipulation required than in this stage of the operation for hernia. The hands should be clean, and if much manipulation of the intestines while in the act of returning it be requisite, should be oiled. The degree

of tension may next be examined, by introducing the point of the finger through the contracted neck of the opening into the abdomen, the parts freed as much as possible from the presence of any fold of intestine or omentum, and a director, as deep and broad as possible, passed to the extent of about an inch into the abdomen. While this instrument is held firmly against the contraction by the operator, it is the duty of the assistant to protect the intestine in the sac by depressing it on all sides. The division of about a quarter of an inch will generally suffice for the return of the protruded contents. The restoration of these parts into their natural cavity requires some

Fig. 69.



tact in its management, and should be executed with peculiar gentleness. If the opening made require any force to be employed in returning the bowel, it should be enlarged: for the addition of such a section is infinitely less mischievous than the injury that may accrue to the intestine by rough manipulation. The index finger should be introduced through the ring into the abdomen underneath the bowel. In the act of introducing it, a portion of intestine, nearly of the length of the finger introduced, will slip up, and should be retained by slight pressure from the other hand. If the palm of the hand first employed be expanded to receive the protruded

bowel, the operator will be enabled better to appreciate the line of the intestine, which should be kept moderately tense below the ring, in order that it should pass longitudinally, and without fold, through it, and that too much of its length should not be attempted at one effort. Care should always be taken that the contents of the intestine pass with the intestine itself, otherwise we are subject to an accumulation of the intestinal contents towards the end, and the return of the last few inches is rendered extremely difficult. When, in operating for hernia, the large intestine is involved, it is better to puncture the intestine by means of a fine needle, and let out the contents, than to make rough or protracted efforts to replace it. I have frequently done this with advantage.

An important question has arisen of late years, on the expediency of opening the sac in hernia. It is urged, by the advocates of its inexpediency, that the danger of the operation is materially lessened by leaving the sac entire, that inflammation is less probable, and recovery more general. Common sense would certainly revolt from any practice that was acknowledged dangerous, as compared with another that was positively less so, whatever the theory or principle involved. The proposers of this new feature in the operation for hernia have found powerful advocates in the persons of the late Mr. Aston Key and Mr. Luke, who have given decided testimony in its favor, and assuredly the proposition demands consideration.

The argument employed is, that it renders the operation less dangerous than when the sac is opened: but, before the force of this argument can be admitted, the experiment must have been tried on a large number of cases; I should say, on some hundreds, a number which the hospitals of England would furnish in a few months. Undoubtedly safety is the first consideration, and is paramount to any; but it is not the success of a few cases, however great, that can outweigh the advantages which the opposite practice of opening the sac furnishes to the surgeon, and consequently to the patient. If, indeed, it be established as an incontrovertible fact, that the mortality after operations for strangulated hernia is less when the sac is not opened than when it is, it does not necessarily follow that it is from the injury done to the sac, by dividing it, that danger emanates. The mortality consequent on dividing the sac may *possibly* be attributable to the exposure of the intestine to the air, or to the more protracted nature of the operation, or to the immediate contact of the hands with the intestine; and the

question is, supposing it to be dependent on one of these, or other similar causes, whether such source of evil may not be avoided, notwithstanding the sac be opened. It appears to me, that we are justified in looking wide for an explanation of the success attendant on the reported cases, when we consider the weight of evidence obtainable on the opposite side, which seems not simply to justify, but absolutely to require the division of the sac. Some of these arguments are enumerated in the following. The sac of an old hernia especially, although continuous with, and originally forming a part of the peritoneum, holds no relation with it in function, has become very dissimilar to it in structure, and takes no part in the diseases and liabilities of the parent membrane. Its very supply of blood is derived from the subserous tissue of the scrotum—a source quite foreign from that of the bulk of the membrane within the abdominal cavity. Its diseases are its own, and, as such, are incommunicable to the general membrane within. How often do we meet with abscess in the sac after operations for hernia, to which we attach no idea of danger, because we know that the line of junction precludes the transmission of suppurative action extending within the cavity; as in a case of phlebitis, the inflammation of the lining membrane often ceases at the junction of the first large branch. We never observe, on the other hand, that peritonitis extends from the membrane into that portion of it that constitutes the hernial sac.

Again, although inflammation of the peritoneum extends by *continuity* of surface, its extension by *contiguity* is yet more positive. We do not trace inflammation of this membrane extending from the divided sac as the centre of mischief; if we usually did so, the fact would be notorious, and the pathology acknowledged; but, on the other hand, the gut itself should rather be deemed the centre or focus of inflammation, when carried back into the midst of the intestines, already prone to inflammatory action, by reason of the interruption given to their natural functions. This extension by contiguity is palpable by the lines of adhesion, and the tinge of discoloration formed on all the intestinal surfaces contiguous to each other. If peritonitis have any recognized point of origin, it is in the inflamed intestine, and undoubtedly there is no comparison between the degree of inflammation affecting the peritoneal lining of the intestines and that lining the walls with which the sac is continuous. In order to produce general peritonitis, when originating in the divided

sac, it must travel over the entire half of the abdominal walls, to reach that portion of the membrane which examination after death exhibits as most highly inflamed.

The necessity of examining the condition of the intestine under most circumstances renders the division of the sac scarcely a matter of choice, not that I would attach an undue importance to this argument. And yet, supposing the intestine to be gangrenous, and returned into the abdomen, what consequence must inevitably follow? Although this condition of the intestine is not commonly met with in operative surgery, yet it may exist in any given case. It is, in truth, always a satisfaction to see the intestine, and to ascertain whether its condition be healthy or otherwise. Moreover, all authorities on hernia describe cases, the strangulation of which depends on thickening of the sac itself. If the intestine in such a case, and I have myself seen several, be returned into the abdomen still entangled in its own stricture, death must follow. It appears to me that the difficulty of returning a large mass of intestine into the abdomen, unless the sac be opened, is greatly increased, for we lose the advantage of taking the intestine piecemeal, and replacing it by the gentle form of manipulation I have above described. In fact, it requires to be thrust back in mass, and I am satisfied that the difficulty must often be very great.

Finally, I have seen the operation attempted many times by experienced operators, who have failed to complete it, and who were compelled at last to open the sac. I apprehend that the attempt to cut on a tight stricture from the outside, and to divide it down to the sac, enhances the difficulty of the operation for hernia in a very great degree, and I can only repeat my assertion, that I have seen it, on many occasions, abandoned by men of the highest competence in our profession, and who now rarely undertake it. With these impressions on my mind, I cannot advise the attempt being made, except very occasionally. In old hernia, where the protruded part is large, and the parts thickened, where the stricture is not palpably referable to the structure of the abdominal rings, or confined to that of the abdominal walls, or when we have reason to doubt the vitality of the intestine, under all such circumstances, I consider that, in the present state of our knowledge, it would be more expedient to open the sac, and to expose the intestine.

Any general description of the anatomy of hernia would be irrelevant to the purposes of this work; yet I may be permitted to recall

to the reader's attention a few of its more prominent features, and I commence with inguinal hernia. Poupart's ligament, which divides the line of the abdomen from the thigh, is stretched across from the anterior spine of the ilium to the spine of the os pubis. The aponeurosis of the external oblique is connected to its upper surface, and forms the external ring, close to the os pubis. The internal oblique and transversalis muscles arise from the outer half of the ligament, and their lower edge descends nearly parallel to it, becoming tendinous, and being attached to the os pubis behind the ring which they thus assist in closing. The fascia transversalis, constituting the third layer, is connected to the whole length of the ligament, from which it ascends between the transversalis muscle and the peritoneum to the extent of two or three inches. At a distance of about one inch and a half obliquely outwards from the external ring, nearly along the line of Poupart's ligament, and immediately above it, this fascia is perforated by the spermatic cord, receiving from this fascia a funnel-shaped process of fibrous tissue, which immediately invests the cord along the canal. Passing below the internal oblique, the cord receives the cremaster muscle, continued upon it down into the scrotum; and, lastly, reaching the external ring, the cord descends, lying on its outer edge, and from this ring it acquires an additional fibrous investment from the pillars of the ring.

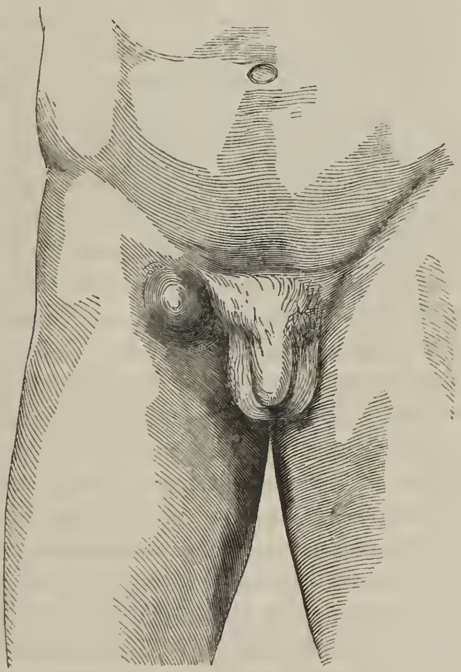
Behind all the parts yet alluded to, the iliac artery gives off the epigastric, which curves along the inner side of the opening in the fascia transversalis, hooking round the spermatic cord to ascend towards the mesial line. Such is the relation of this artery to the cord, that it will always be found to its inner side, and immediately in contact with it, whether the opening be small and placed nearly mid-distance between the attachments of Poupart's ligament, or whether in old hernia this internal opening be dragged towards the mesial line behind the outer ring.

This general view of the anatomy of oblique inguinal hernia will suffice for my purpose. The intestine descends along the line of the cord, raising from off it its various investments of muscular and fibrous tissues. A second modification of this form of oblique inguinal hernia consists in a protrusion of intestine under the *tendon* of the internal oblique muscle, through the outer part of the external ring, which is protected by the fascia transversalis alone. The greater liability to the occurrence of this modification, called *direct* or *ventro-inguinal*, depends on the greater or less development

of the tendinous insertion of the internal oblique muscle behind the external ring. *Oblique* hernia lies upon the cord from which it has separated the coats; *direct* hernia on the inner side of the cord, having no common investment with it but that which both derive from the external ring. The epigastric artery lies a full inch to the outer side of the opening through which direct hernia occurs. The seat of stricture is at the lower border of the internal oblique in both these forms of hernia; or, to speak more correctly, the division by the knife of the lower border of the muscle or its tendon will remove the stricture, and not that they alone cause it. The cause of stricture is a general one, but in this direction we may divide it with the least difficulty or danger. By dividing the muscle straight upwards, we avoid the epigastric artery, whether in oblique or direct hernia.

A description of inguinal hernia is not infrequently met with, in

Fig. 70.



which, in the course of the operation, on the sac being opened, the testicle presents itself at the bottom of an elongated cavity. This

form of the disease is called congenital hernia, the intestine having followed the track of the testicle in its original descent from the abdomen into the scrotum. But examples occur in which this disease first appears at manhood, and are explained only by supposing either that the testicle must have descended late in life, or that a portion of omentum may have passed down with it at the time, and retained the continuity of the passage with the abdomen.

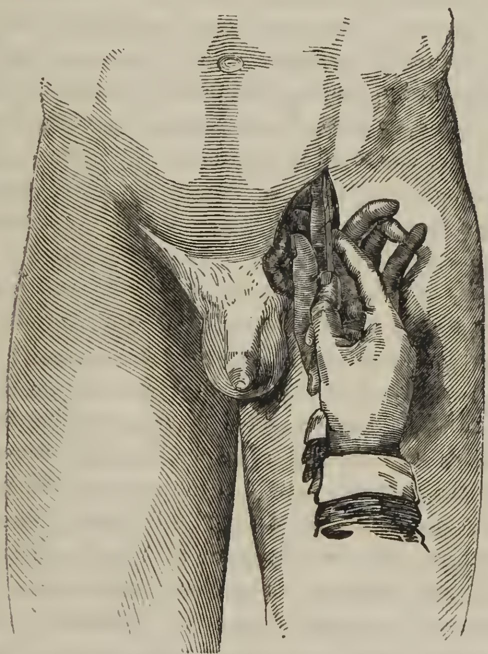
Although the distinctions between inguinal and femoral hernia are usually made without difficulty, yet cases occur in which the distinctive characters of the two are not readily observable. The question is settled by tracing the line of Poupart's ligament, which passes over femoral, and under inguinal hernia. Inguinal hernia is the prevalent form in the male; femoral, in the female. Inguinal is longitudinal; femoral, obtuse, rounded, and sometimes transverse; but the difficulty is most readily removed by tracing the line of the ligament by the hand. Inguinal hernia may present itself in the form of a slight swelling, or fullness of the canal; or in that of a bulky tumor, occupying the scrotum. In whichever form it appears, the axis of the tumor is the guide for the first incision.

Operation for Inguinal Hernia.—The skin is to be shaved. In the longitudinal tumor an incision is made, commencing half an inch above the situation of the external ring, and carried downwards on the tumor to an extent proportioned to its size. If very large, it may be prolonged to four inches in length, or even longer; if in the canal, before it has reached the external ring, the incision should take nearly the direction of the canal, or parallel to Poupart's ligament. Taking the first form as the supposed example, the skin may be divided by a fold, including the line for division, being raised between the operator and the assistant, and cut directly through, either from the skin downwards, or by puncture from within outwards. The incision thus made should fall into the required line. The division of the textures below should be carried on, till the layer of fibres arising from the external ring is divided; and at this stage we ought to be enabled to tell whether the hernia be oblique, or direct; for hitherto the investments would be held in common by the two. If it be oblique, the cremaster muscle will present itself, covering the tumor, and the cord will not be seen, from its position behind it; if it be direct hernia, the cremaster will retain its relations to the cord, which will lie to the outer side of the hernia.

In the case of oblique hernia, the layer comprising the cremaster

muscle is next to be divided, and the funnel-shaped fascia from the internal ring, or in that of direct hernia, the prolongation form of the fascia transversalis, and the sac is exposed. If the hernia be large, the different layers as they are exposed should be divided nearly to the extent of the external wound. The sac may be opened by pinching up a point by means of a fine pair of forceps, or raised by means of the tenaculum. A gush of fluid follows, often in considerable quantity, to the alarm of young operators. The sac is to be slit up to the extent of the other membranes, and its contents examined. The omentum, if not adherent, should be opened, and the intestine will lie behind it. The degree of tension of the ring should be examined by the finger, and a director introduced

Fig. 71.



upon the omentum into the abdomen, great care being taken to depress the intestine, and to keep it out of danger. The knife invented by Sir A. Cooper, and which bears his honored name, is then passed into the groove, and through the ring, into the abdomen, on its side. Reaching its destined height, the edge is turned straight

29

upwards, and the obstructing margin divided to an extent proportionate to the size of the mass to be returned. The contents of the sac are then to be replaced in the abdomen, always beginning with the intestine, and ending with the omentum. When each is thoroughly returned, the finger should be passed gently into the cavity, for the purpose of pressing the bowel, as far as possible, from the neighborhood of the ring, and thus tending to prevent its immediate return. We are often troubled to know what is best to be done with the omentum, when the intestine is returned into the abdomen. The condition of the omentum, as well as the quantity remaining in the sac, are important elements in this decision. If the quantity be small, healthy, and unconnected to the sac, and the opening sufficient to enable the surgeon to return it without difficulty, there is no excuse for removing it. If adherent to the sac below, in the case of a large cavity, and especially if it be altered in structure by being thickened—and I am not familiar with the changes alluded to by some authors, and especially by Velpeau, who speaks of its being, in some instances, as largely charged with fat, becoming twisted, clustered into *pelotons*, and forming hard tumors, similar to scirrhous—it is reasonable to infer that its return into the abdomen might be a source of evil. Under these circumstances it is better removed than returned.

The quantity to be taken away should be regulated partly by the condition of the membrane, and by the necessity of reducing the protruded mass as much as possible in relation to the outer wound. In the rare cases in which the omentum is gangrenous, its entire removal beyond the dead structure is inevitable. If the omentum above the divided edge be healthy, it may either be returned into the abdomen or left in the wound. When cut asunder, the healthy omentum will often bleed freely; whereas, we can divide large masses of the membrane that has been subject to long pressure, and has undergone the changes incidental to it without the application of a single ligature. Whatever vessels are tied should be secured singly, with fine silk, and the threads cut off closely. As a general rule, it is perhaps better, if it be necessary to divide the omentum, unless perfectly soft and healthy, and especially so if several ligatures have been employed, to leave the cut surface in the wound and occupy the ring, instead of passing it up entirely into the abdomen. If cut close, the omentum will probably become adherent to the margins of the ring, and render the recur-

rence of hernia somewhat less probable. It is not, however, so definite a point of practice as to justify a very positive opinion.

Very troublesome cases of inguinal hernia occasionally present themselves to the surgeon, in which the protruded intestine consists wholly of cæcum. This portion of the large intestine may present itself, deprived of a sac, consequent on its anatomical relations while in the abdomen. In such cases, the peritoneum lining the walls of the cavity is reflected over the mesial surface of the bowel, leaving the outer surface, which lies low down in the iliac fossa, entirely uncovered by the membrane. If, in such examples, hernia occurs, this intestine is protruded by that surface which is nearest to the ring, and consequently it descends without a sac. The difficulty that attends these cases of cæcal hernia consists in that of the retention of the bowel, when returned into the abdomen. If the bowel be replaced, it immediately falls again through the ring, and, indeed, it is not invariably in our power to replace it, from its adhesions around the neck of the tumor. Thus it becomes inevitable, after freely dividing the stricture, to leave the intestine outside the abdominal cavity, and to provide it with integumental covering as speedily as possible.

Hernia strangulated in the Canal.

We meet occasionally with cases of recent occurrence, in which strangulation has appeared early in the progress of the disease. The tumor is necessarily small, being bound down by the aponeurosis of the external oblique muscle. Its situation is above Poupart's ligament, and between the two rings. The incision should be made along the line of the canal, about half an inch above the ligament, two inches in length, and the skin and superficial fat and fascia divided. By this incision the superficial epigastric artery is cut asunder, and should it bleed may be at once tied, if the flow of blood cause obstruction to the operation. The aponeurosis of the external oblique muscle is to be divided to the extent and in the direction of the external incision, upon a director. The cremaster muscle will then present itself, expanded over the hernial tumor, which has raised it from the front surface of the cord. This muscle and the funnel-shaped fascia produced from the internal ring are then divided, to an extent sufficient to bring the tumor clearly into view, covered by its sac. In this case, of recent occurrence, it may be

practicable to return the intestine through an unopened sac, and the attempt may and ought to be made, and in this condition of the parts so recently displaced, and probably so unaltered in texture, the sac may be returned with the bowel into the abdomen.

A peculiar feature occasionally presents itself on exposing the sac in an operation for hernia, viz., that the cord is separated into its component parts, some of which may lie in front of the intestine, others at the side. These relations, indeed, when the cord is so split, may assume any variety of arrangement. Although it is necessary to know that such varieties exist, it demands no further observation here, beyond that of enjoining especial care that such textures be uninjured in the after steps of the operation. Inasmuch as the cord will, in all probability, be more or less attached to the sac, there can be no advantage derived from their separation by the knife.

On opening the sac in hernia, the intestine may assume any variety of color or appearance between that of health and that of gangrene. This variety includes all the colors incidental to every degree of inflammation or congestion. True gangrene of the gut is a rare occurrence, and is only found after several days strangulation, the product of gross neglect on the part of the patient, or his friends. It is very important to distinguish between extreme congestion of the vessels and the death of the intestine. In the latter, the structure assumes a slate, or even nearly a black color, in patches; it has entirely lost its polish; its surface is filamentous; it presents a smell of fetor, and when advanced, even the integuments above are involved in the diseased action, and bear testimony to the altered condition of the parts within. When the bowel is gangrenous, there is no doubt of the fact in the mind of the observers. It is apparent and unequivocal. This condition of the intestine is not confounded with a high degree of congestion of the vessels, although a question may be raised in the latter condition of the parts, as to the existence of gangrene. In every state of the intestine, short of gangrene or rupture, whether by laceration or by the knife, it should be returned into the abdomen. If gangrenous, we have no alternative but that of dividing the stricture freely, and laying open the intestine with the knife, with a view to form a permanent opening, or to be employed, at least, as such, until a subsequent attempt be made to close it; for such an operation is performed, and with occa-

sional success. Under these circumstances the intestine is, of course, left in the sac.

When dependent on congestion of vessels, the intestine, however unpropitious in appearance, is often restored to a healthy color with wonderful rapidity. I operated on an old man for hernia, in the Charter House, three months ago. The quantity of intestine in the sac was very large, and, I think, more highly congested than I had ever seen it. The first impression on my mind was that it had lost its vitality; but it was free from fetor, and had not lost its polished surface, or become filamentous, and the discoloration was universal, and not restricted to patches. Under these circumstances I returned it into the abdomen. The man progressed favorably; the wound, which was very large, healed quickly to within three quarters of an inch of its length. At the expiration of the third week, during a violent fit of coughing, the action of the abdominal muscles forced the intestine down into the sac, tore open half the wound, and even thrust at least four feet of intestine out upon the abdomen, no part of which bore testimony to its previous discoloration.

In operations for hernia, a small opening in the intestine occasionally presents itself, giving very unequivocal evidence of its involving the entire coats of the bowel, by the oozing of the fluid contents through it. The wound has all the appearance of a recent injury; but against this view of the subject, the operator, who ought to be the best authority, invariably asserts that he did not divide even in the direction of the wound, and no one can declare that he did, and in our profession none will venture to suspect the instrumentality of the operator, against the evidence of his own unimpeachable testimony, therefore it is concluded that the intestine was torn in drawing it down, or referable to some other unexplained and mysterious cause. Such at least was the line of argument followed in a case in which I was myself the possible delinquent.

After all, the injury is not very great, the wound should be united by one or two threads, passed through the serous and muscular coats only, and the intestine may be safely returned into the abdomen, even though the wound be not entirely closed by the suture. The patient I allude to recovered.

When the above stages are concluded, the outer wound should be united by the interrupted suture, deeply introduced in loose integuments, great care being taken that the ring be kept free from intes-

tine. A pad of lint should be placed over the ring, and over the pad a large handfull of cotton wool, or in its absence a folded towel or masses of lint, so applied as to compress the ring from below,

Fig. 72.

without involving the walls of the abdomen. Over these, a bandage should be dexterously applied, like the figure of 8, passing round the abdomen and the thigh of the affected side, fixed by a needle and thread, or by pins at every turn, as it passes over the compress, and from that point carried back. By this means the compress will form the centre of pressure.

As regards after treatment, it should be, for the most part, passive. If the sickness subside, and the bowels act quickly, it is a favorable omen of recovery, but should some hours elapse without action, it is no excuse for the administration of drastic purges. It is difficult to lay down any specific rule on this subject, so various may be the indications, but I believe it is better to leave a patient alone. If, however, at the expiration of twelve or eighteen hours, no action appears probable, a mild aperient may be given, in the form of manna with some compound decoction of aloes, or mild form of neutral salts with some tincture. The intestine may also be excited to action by enemata of warm water with salt, or other mild purgatives, not to be repeated with too great frequency.

Inflammation, if at all, will probably not appear before the day but one following, i. e., forty-eight hours after the operation. It is

very essential that we distinguish the general pain and uneasiness about the abdomen, attendant more or less on all operations of this region, and which are very deceptive in character, from the signs of true inflammation.

In the endeavor to distinguish between the signs of true and false inflammation, I must again refer to the equivocal marks of the one, and the conclusive characters of the other. True inflammation can hardly be mistaken. Pain in the abdomen, at first confined to a region, but becoming general; increased in proportion to the degree of pressure of the hand, and not suspended or forgotton when the patient's attention is directed to other subjects, under which circumstances the same pressure often affords relief in false inflammation; or, at least, the pain in such instances bears no proportion to the extent of the pressure: hot skin; pulse small, but hard, and more than usually frequent, though far within such frequency as shall characterize simple disturbance of the nervous system, when it may beat from one hundred to one hundred and twenty pulsations in a minute; restlessness, without movement; anxiety of countenance, distinctly marked and expressive of suffering; the knees drawn up, and the body bent forwards, in order to relax as much as possible the abdominal muscles—these are the symptoms that mark the progress of true peritonitis. The mock symptoms may make their appearance on the day following the operation, or at any time; and may be allayed by such remedies as are applicable in any other case of nervous disturbance. The true peritonitis may, I believe, be developed by the unnecessary resort to active depletion. I think I have seen it frequently productive of much serious mischief. I believe that we render persons more liable to such inflammation by the resort to any agent that tends to lower the tone of the nervous and circulating systems, and that we should be very careful how we employ these agents of depression. If they effect no good, they perpetuate a serious mischief. The more we bleed the more prominent do the symptoms appear, and in the same ratio with the loss of blood. The same remarks will apply, though in a lesser degree, even to the treatment of true inflammation, which feeds and fattens on depletion of any kind, or of either system. Nothing can be more injurious, and more probably fatal, than the large application of leeches applied to the abdomen in our public hospitals, for the cure of peritonitis—real or supposed. For many years past, having had abundant opportunities of observation, I have observed that the recovery of a

patient who has been subjected to the repeated application of these agents of mischief is rare indeed.

When the symptoms of positive inflammation appear, and when there is nothing in the present condition or in the system of the patient to preclude it, he may be bled largely at once from the arm; or locally, by the application of three or four dozen leeches; his system being at the same time sustained by mild stimulants, if necessary. The bleeding should be sufficient to affect the disease at once; and from that time I believe our reliance should be placed on mercury, conjointly with opium, given freely. Of these two last-named remedies, I do not know which is the more valuable in the treatment of such a disease as peritonitis. With respect to the influence of mercury, its agency is sufficiently recognized throughout the profession; but not so as regards the action of opium, and I look forward to the time when its employment in inflammation will raise less alarm in the public mind than it does at present. The action of mercury may be obtained both by the mouth and by inunction; and, in reference to the latter mode of administration, a mass of the ointment of the size of a hazel-nut may be slightly rubbed in each axilla, and left for absorption.

Femoral Hernia.

Femoral hernia descends underneath Poupart's ligament, through an aperture left between the femoral vein on the outer, and the crescentic fold of Poupart's ligament, called Gimbernat's ligament, on the inner side. This opening in the natural state is about sufficiently large to admit of the extremity of the little finger. Sir Astley Cooper speaks of this opening as being occupied by an absorbent gland. If so, the presence of the gland is the exception, and not the rule. Poupart's ligament bounds this aperture in front; the femoral vein on the outer side; Gimbernat's ligament on the inner side; and behind is the continuous layer of fascia descending from the iliac fossa, and covering the bone and pectineus muscle, to become fascia lata. The hernia lies on this portion of the fascia lata, which is connected yet more internally to the os pubis. This aperture is called the femoral ring, and forms a part of the general opening, through which the vessels descend from the pelvis into the thigh; but the vessels on the outer side are invested by a sheath of fibrous tissue, which descends upon them down the thigh. The

hernia cannot be said to enter into this sheath, but to lie on the inner side of it, in consequence of the sheath which invests them not being derived from the entire of the crescentic oval, cut for the descent of the vessels, but only from that part of the oval with which they are in contact; viz., the outer two-thirds. This small aperture is filled with cellular tissue, which by the descent of the intestine is shaped into a coat, generally called, though by no means universally, the *fascia propria*.

The investments of femoral hernia, as found in dissection, are simply the superficial fascia, as it is termed, placed between the integuments and the fascia lata, and the above-described fascia propria. But the operating theatre often discloses to the view a laminated texture, similar to that of inguinal hernia, and consisting occasionally of several layers of fibrous membrane, each of which has to be divided in the operation.

The epigastric artery is at a distance above the neck of the sac, and behind the flap of the abdominal muscles, and holds, therefore, no relation to femoral hernia. One artery only may be involved, viz., the obturator. The obturator artery, which is commonly a branch of the internal iliac, is occasionally produced from the epigastric, and when so produced, almost invariably descends from its origin so closely on the inner side of the femoral vein, as to lie on the outer side of the neck of the hernial sac, and as we divide the stricture on the inner side, it is free from danger. But if the epigastric travel any considerable part of its course inwards before the obturator arise from it, the latter vessel is brought nearer to the mesial line, and may descend on the *inner side* of the hernia, instead of the outer. Under such circumstances it is liable to, and indeed is almost certain of, division in dividing the stricture.

Rare as these concurrent circumstances necessarily are, I was so unfortunate as to be required to operate some years ago in such a case. A gush of blood followed the division of Gimbernat's ligament, which induced me immediately to exclaim, that I had divided the obturator artery. I succeeded in tying the lower end of the vessel, but failed to reach the upper. The bleeding continued slightly for some hours, and then ceased. On the third day the woman, apparently full of life and strength, was progressing well and promisingly; indeed, I had no reasonable cause to doubt her recovery. Twenty-four hours having elapsed without action on the bowels, a very reflecting dresser, in my absence, ordered her four grains of

calomel and ten of colocynth. Under the influence of this very appropriate agent, the woman sustained an attack of diarrhœa, and died on the sixth day.

In the attempt to reduce a femoral hernia, we must always keep in mind the situation of the ring, which lies at the inner and upper part of the tumor, towards which it should be drawn. Some benefit is derived, in the endeavor to return the hernia before operating, from the position of the thigh, which should be raised and rotated inwards, in order to relax, as much as possible, the fascial structures involved in the formation of the opening through which the intestine has descended.

The peculiar form of a femoral hernia has been referred to the close adhesion of the fascia of the thigh. Some have attributed it to the direction given to the tumor by the lesser falciform process of the fascia lata, which has always appeared irrational enough. It appears to me that the feature is best explained by the necessary angle at which the thigh is brought in the act of sitting, during which the hernia is forced upwards, towards, and sometimes over, Poupart's ligament.

Operation for Femoral Hernia.—The upper part of the thigh should, if necessary, be shaved. The line of the first incision is regulated by the necessity of obtaining an entire command over both the protruded parts, which lie more or less in a transverse direction, and the femoral ring through which these parts are to be returned. A longitudinal incision would hardly command the tumor, or a transverse one the femoral ring; and yet the line is not necessarily made midway between them, but should always hold a closer relation to the ring than to the tumor, because the difficulties of the operation lie rather with the former. I do not see the necessity of a second incision at right angles, because there is no advantage gained by cutting on to the tumor, the contents of which, when exposed, may be drawn inwards in a line with the ring.

The dissection is carried down to the sac, as in inguinal hernia, and the sac, if necessary, should be divided, as before described, either by pinching it up with a pair of fine forceps, or by raising a point of it with the tenaculum. The tension of the ring is usually greater than in inguinal hernia, unless the latter be of recent occurrence. Often the nail alone can pass through it. The director being introduced, the stricture should be divided *inwards*, or *upwards* and *inwards*. The relief to the stricture afforded by the

division of Gimbernat's ligament horizontally inwards, cannot extend beyond about one-third of an inch. If, therefore, the tumor be larger than usual, it is better to make the division of Poupart's ligament, upwards and inwards, because in that direction it may be prolonged, if necessary; or, having divided Gimbernat's ligament, that upwards and inwards may be superadded. Ever since the operation in which I divided the obturator artery, I have invariably employed a blunt knife for the division of the stricture in femoral hernia, sufficiently sharp to cut the ligament by the aid of some pressure, but which pressure is likely to push the artery before it, should the vessel happen to occupy the regular position in question.

Umbilical Hernia.

In this form of hernia the intestine escapes from the abdomen, either through the original foramen, formed by the entrance of the umbilical cord, or through a fissure close adjoining to it. Placed in the centre of the great anterior wall of the abdomen, with which the large mass of the intestines is in immediate relation, and the muscular pressure on which is more direct than in any other form of hernia, this hernia assumes occasionally an enormous magnitude, including in the protrusion nearly half of the small intestine. The opening or neck is in the linea alba, and is fibrous in texture. Generally the thin, though dense integument covering the navel, is elongated, or expanded over the surface of the tumor; and this integument, lined by a polished surface within, constitutes the sole covering of the protruded intestine. Unlike other kinds of hernia, the umbilical form has no separate sac, for the peritoneum being compressed against the integuments, without the intervention of either fascia or fat, becomes closely adherent to it, and gives it the polished appearance I have alluded to. This polished membrane is the peritoneum. Consequent on the large size, and the comparative rapidity of its increase, the integuments yield irregularly to the influence of the expulsive force from within, and the entire cavity is separated in large and capacious sacculi, communicating with each other in the centre. Each of these sacculi is filled with intestine. Such, at least, is the condition of the larger forms of umbilical hernia. There is more danger attached to umbilical than to either of the other forms I have described; probably because the

operation does greater violence to the walls, and is nearer the centre of the circulation.

Operation for Umbilical Hernia.—The operation for umbilical hernia, in description, is very simple. A longitudinal incision should be carefully made in the upper or lower surface of the tumor, of a length proportioned to its size. There is no reason for making it excessive, yet it should be of sufficient length to command the contents of the tumor. When the cavity is exposed, portions of the intestine may be drawn from the sacculi, and the finger passed down to the neck, and through it into the abdomen. The neck should be bared of intestine at the upper or lower part of the circle; the opening will be found sufficiently capacious to render the resort to the director quite unnecessary. Indeed, the finger is always to be preferred, if it can be introduced with ease and safety. The neck should be divided to the extent of half or three-quarters of an inch, or it may be divided both above and below. It is always better to make this division in the linea alba, because there is no reason why the recti muscles should be involved. In returning the intestine, if any difficulty be experienced, the abdominal muscles may be raised by introducing the finger through the opening, and drawing them upwards, so as, in fact, to enlarge the cavity into which the intestine is to be returned. By such means the intestine will often be replaced without much manipulation, or loss of time. No vessels are involved in this operation, which is almost bloodless. The greatest care is required in applying an efficient compress, after the wound is brought together by suture. A firm pledget of lint, corresponding to the size of the opening through the linea alba, should be placed over the ring; and a second, somewhat larger, applied upon it; and a third, or even a fourth, if the patient be very fat. These pads are buried below the level of the fatty parietes of the abdomen, and may yet require a mass of cotton wool, or the substance of one or two towels, to complete the requisite mass for pressure. A flannel roller should be carried repeatedly round the abdomen, fixing the immediate agent of pressure in its position, or this end may either be obtained by the application of very broad and long strips of adhesive plaster, or by the hernial truss which has been previously worn, provided it prove efficient to the purpose.

The after treatment in either femoral or umbilical presents no peculiar features distinct from other forms of hernia. In all probability, general tenderness of the entire cavity will be more manifest

after the operation than in hernia of the inguinal or femoral rings, but this tenderness must be distinguished from advancing inflammation, and it will be distinguished by all observing surgeons.

Three fundamental errors in treatment of strangulated hernia characterized the old school of surgery, and the evils of which are only now waning under the influence of more enlightened knowledge of the human economy. The first of these consisted in the undue postponement of the operation for its relief. Does this practice infer an unjustifiable confidence in the remedial agents resorted to before the operation, or a well-grounded fear of the result after it? Of the two causes, the latter would appear the more reasonable. The old surgeons might well entertain a very reasonable fear of the result of their cases, when so many hours or even days were allowed to elapse, under strangulation, by so highly organized and so sensitive a structure as the small intestine. To meet this evil, the operation should be executed with all reasonable speed, limiting the remedies employed prior to the operation to a few only of the most influential, and acting on the acknowledged principle of the golden rule, that an operation for strangulated hernia increases in danger as every hour elapses. The second cause of mortality consists in the violence done to the intestine by the ineffectual attempts to return it by the hand, and it is marvellous to hear that a surgeon of the high and deserved renown of Sir A. Cooper should have advised the application of the taxis for a period of half an hour at one time. I have myself seen many hundreds of cases of strangulated hernia, and except in most rare and accidental examples, I have never seen success attend a longer-continued effort than a very few minutes. In this respect the mischief that is perpetuated under the prostituted name of medical science is frightful to contemplate. I have seen the severest forms of inflammation—ecchymoses, effusions of blood, and abrasions of surface, that could only be referred to the long persistence in the most dangerous, and the inefficacious, because ill-timed, of the remedial agents employed. Thirdly, the resort to immoderate depletion after the operations marks the practitioners as deficient in the possession of a true medical philosophy. Because blood is found in excess, therefore reduce its quantity and you restore the parts to their pristine condition of health. If such be the standard of our knowledge, the public has yet much to suffer and the profession much to learn. Inflammation is an effect, and not a cause! We deplete, even largely, to obviate its consequences,

and having depleted, it is even better to contend against relapse by the administration of a stimulant, than to resort to further depletion.

After the operation for strangulated hernia, the patient is by no means exempt from liability to a return of the disease. Here and there we meet with a case in which the disease is radically cured, but it is rare. Divers plans have been suggested by which to obliterate the opening through the walls of the abdomen. It has been proposed to leave a piece of omentum to occupy the ring, and also by others to effect the same object by its entire removal, to dissect off the sac, to notch the ring, to pass a ligature around the sac, by which it is to be firmly tied below the neck. The old surgeons used to commence this operation by castration! But the truth is, that the operation itself involves all the care and attention of the surgeon at the time. The return of the disease is so slight a consideration, when compared with the serious evil which rouses all the anxiety of the surgeon, that it is not surprising so little has been effected, to say nothing of the difficulty at all times experienced in supplying the place of deficient material. When the ring is large, the difficulty of filling it up by the application of internal agency appears almost insuperable, and the attempt to do so will but aggravate the danger. Much, however, may be done by after management. A truss should be resorted to as early as its pressure can be borne; and this pressure, if applied in moderation, is not incompatible with the healing of the wound. As soon as the outer wound is partly cicatrized, the truss should be reapplied and worn constantly, and when the process of union is complete, firm pressure, by means of a powerful truss, or by the application of a roller with suitable pads, should be worn, and the firmest pressure employed that the patient can bear. This, of course, should be commenced early, and before the neck of the sac has been reopened by the descent of any part of the intestine. For this purpose, a strong truss, the pressure from which is general, appears to me the most suitable. For such purposes, I know no truss more effective in retaining the intestine within the abdomen, and occasioning less discomfort, than that recently invented by Mr. Dartnell, an army surgeon, and bearing his name. The pad is made of polished wood, and is so formed as to fit accurately into the hollow of the groin. It has also the advantage of being remarkably light.

There are, however, numerous other inventions of great merit, claiming the advocacy of surgeons of rank and experience.

CHAPTER XVI.

OPERATIONS ON THE EXTERNAL ORGANS OF GENERATION IN THE MALE.

PHYMOSIS.—PARAPHYMOSIS.—HYDROCELE.—TEMPORARY, OR PALLIATIVE TREATMENT.—PERMANENT TREATMENT.—HEMATOCELE.—CASTRATION.—CATHETERISM IN A HEALTHY URETHRA.—CATHETERISM IN CASES OF FALSE PASSAGE.—CATHETERISM IN CASES OF ENLARGED PROSTATE GLAND.

This operation is required either in consequence of disease, or of congenital deformity. A congenital contraction in the transverse diameter of the prepuce is not uncommon. The exposure of the surface of the organ is somewhat essential to health and to cleanliness. The secretions of the small glands in this region are liable to become morbid, and the evil resulting from inability to expose the affected surface is often great. It is very possible that the constriction of the prepuce might be overcome by persevering art, without the aid of the knife, but the process would be tedious and unsatisfactory, and as a far less troublesome and more conclusive measure, we resort to a division of the constricted portion.

The prepuce is composed, as is well known, of an external layer of skin, and an internal layer of modified mucous membrane, with cellular tissue inclosed between them. The morbid condition is seated almost exclusively in the inner, for the outer layer or skin is distensible in a far greater degree than the mucous membrane, with its cuticular lining. The art of the operator consists in dividing as large a portion of the one, and as little of the other as possible, and it is at the same time a desideratum not to leave the glans entirely denuded. To meet this indication with nicety is not easy, by the operation commonly adopted. If an incision be made longitudinally through the entire prepuce, little benefit will be ultimately gained, for the wound will reunite as before, and it is often deemed necessary to remove the offending portion altogether.

With this object the surgeon, pinching up the exposed edge of the foreskin with his finger and thumb, places it between the blades of an instrument used for this purpose, by which it is fixed and firmly held. The bistoury is now employed to separate all the membrane projecting beyond the blades. The skin then retracts considerably, leaving a largely exposed and bleeding surface. A director is then introduced on the upper surface, underneath the remaining layer, nearly as high as the corona glandis, which is divided by the bistoury. The angles left by the last incision are simply turned backwards, and the operation is completed. Wet lint may be placed around the penis, and the patient should remain quiet for some days. If too small a portion of the prepuce be removed, the evil will return by the process of cicatrization. It is the custom of some operators to unite the two flaps, formed by dividing the mucous membrane to the edge of the retracted skin, but it is not necessary to do so.

A better mode of performing this operation, and by which a larger portion of skin is retained, consists in dividing the mucous membrane alone. If the integument be of excessive length, however, a small portion should be removed circularly, as in the former operation. This may be done without the aid of the forceps, by a strong pair of scissors. The integument on the dorsum is then pinched up by the assistant, and held firmly throughout the operation. The operator then, introducing a pointed bistoury on a director, divides the mucous membrane from within outwards, immediately underneath the integument raised by the assistant, beginning as high as the corona. The sufficiency of this division is determined by the facility with which the divided prepuce is passed backwards over the glans. It may be well to accomplish this end without the first division of the entire ring; but if so, the mucous membrane must be freely divided throughout its whole length. In the majority of cases, it is unnecessary to remove any portion of the external skin, and all that is required is to elongate the membrane, and to keep the point of the bistoury, while dividing from within outwards, close beneath the outer skin, for not only the inner membrane, but the cellular tissue should be divided also.

PARAPHYMOSIS.

This condition of the prepuce rarely requires the aid of the knife. When the foreskin is retracted behind the glans, under inflammation of any kind affecting this region, it may become swollen by infiltration of serum, more or less albuminous in character, while the permanent constriction around the glans increases the evil, by arresting the circulation through that structure, and if the mischief be neglected when the constriction is great, sloughing of a greater or less portion of the glans will, in all probability, ensue. The natural relation of these parts must be re-established, but this is very often a matter of considerable difficulty, requiring abundant patience and perseverance in its performance. While the thumbs are employed to press out the blood from the distended glans, and to lessen its bulk, an attempt is made with the fore and middle fingers of each hand to drag the prepuce forwards.

Sometimes it is necessary to proceed even more systematically to elongate the penis, and to grasp it in the entire hand, including in the general pressure the œdematous foreskin. This pressure should be continued uninterruptedly, for ten minutes or more, and then the glans should be pressed backwards in the centre, or at the orifice of the urethra; the general integuments of the organ being at the same time drawn forwards with some force.

It may be necessary, in certain cases, to divide the constriction behind the glans before we can succeed in reducing the paraphymosis. This constriction is generally deeply seated, between two folds of the prepuce. Sometimes the extremity of the prepuce becomes so œdematous, that a partial evacuation of the fluid by means of a grooved needle is necessary, in order to accomplish the reduction.

The above rules of treatment are applicable to cases in which the constriction is so great as to demand immediate relief, for many cases of paraphymosis may be safely left to the remedial influence of a poultice and a purgative.

HYDROCELE.

Hydrocele, or water in the tunica vaginalis, is generally the product either of chronic inflammation of the testicle, or of exercise in

excess. Occasionally, indeed, it is not attributable to any apparent cause. When the symptoms which characterize it are well marked, the disease is easily distinguished from any other form simulating it, but its true character is not always clearly ascertained without some trouble.

Hydrocele commences below, whereas hernia, with which it is most likely to be confounded, descends from above. The swelling of hydrocele is generally larger below, and pyriform; hernia is irregular, and often larger above. In hydrocele the ring is unaffected as regards size; in hernia it is largely dilated. In hydrocele the tumor is translucent, on placing a light behind it, or on looking down a tube of paper brought into contact with it against the light. The testicle cannot be felt, because it is within the tumor and forms a part of it, by reason of the relation between the tunica vaginalis and the testicle. In hernia, the testicle can generally be distinctly felt. Hydrocele is unvarying in size, but slow and uninterrupted in its progress; hernia is irregular and influenced by position. We have impulse in coughing in hernia, none in hydrocele. Hydrocele is uniform and elastic on pressure; hernia partially elastic and doughy. Each disease has a history pertinent to itself, of origin, and progress.

Simple hydrocele is easily detectable in its early or middle stages; but when the disease is very chronic, the sac becomes hard, thick, and incompressible; it encroaches on the ring, and loses its translucency. It is then that our powers of diagnosis are called into requisition, and the nature of the disease must be established beyond doubt, because the treatment is critical; a puncture relieves the one, and destroys life in the other case.

When the nature of the disease is not very distinct on a first examination, the scrotum should be drawn down, and the fluid pressed to the bottom of the cavity. This may be done by a gradual process, by which the membranes are distended, or rather elongated. The sac is thus rendered tense, and by being grasped in the hand the nature of the disease is rendered more apparent.

In hydrocele, the testicle is fixed to the back part of the sac, and consequently we puncture in front, directing the trocar from below, obliquely upwards and backwards. This removal of the fluid by puncture is the palliative or temporary treatment. The permanent treatment consists in altering the condition of the sac, and by that means arresting its power of secretion. This object is usually

attained by injecting port wine into the sac, of which the quantity injected is usually sufficient to distend the sac, diluted with water. Care must be taken to keep the canula from slipping out of the tunica vaginalis. The consequence of this application is an attack of orchitis, which is often exceedingly painful and protracted, and often dangerous, from sloughing of the scrotum, and even death has followed.

This disease merits a milder treatment, for the cure is greatly disproportioned in its severity to the disease itself. The acupuncture affords relief for a time, but does not possess the property of a radical cure. If repeated, it is occasionally successful. The best treatment is that of the injection of the simple tincture of iodine, in the proportion of one dram to three drams of water, as recommended and adopted in India on so large a scale by my friend Mr. Martin, who has tried various proportions of the stimulating fluid, and has found by practical inquiry, and on a scale of enormous extent, that the above is the exact proportion, combining safety with the requisite stimulus to arrest secretion. Half an ounce of this compound is injected, retained, and absorbed.

HEMATOCELE.

This name is given to a collection of blood in the tunica vaginalis. The history and symptoms are the following. A tumor, more firm, and less elastic, than hydrocele; impervious to light; occurring suddenly, or within a few hours, of any accidental blow or other form of violence; also occasionally following the operation of puncture for hydrocele; and, when met with in hospital practice, often dated back to injury of some years' date; unchangeable in size or dimensions; heavy to the hand supporting it, and unattended by pain. The introduction of a minute trocar produces bloody serum in small quantity. There is no alternative to laying open the tunica vaginalis freely. Warm water should then be injected freely, to detach the broken-down fibrin which is adherent to the sac. Care must be taken to keep the wound open until the cavity is free; hence the necessity of a free incision. I have known the testicle removed on more than one occasion in hematocele, under the supposition that the organ was itself diseased. I mention the fact as a specimen of surgery worthy, scarcely worthy, the commencement of the early

part of the last century. I dissected one case, and found the vas deferens obliterated.

Mixed cases occur to which the name of hydro-hematocele is given. The addition of blood probably indicates more violent action than usually attends cases of hydrocele; they are, however, amenable to the same treatment as that disease.

CASTRATION.

Castration is a rare operation. It owes its infrequency to the adoption of improved principles of surgery. Castration is only justifiable in cases of disease of the testicles, whose justly-suspected malignancy leaves no hope of its restoration to health. When malignant disease, of which encephaloid cancer is perhaps the most frequent variety to which the organ is liable, affects the testicle, the operation is still contra-indicated, if the disease be far advanced; and especially so when the lumbar and iliac glands are extensively implicated, the presence of which may be ascertained on pressure in the iliac fossa. Under such circumstances, we do but promote the extension of the morbid actions, by resorting to operations, and stir up a more vigorous action, in the place of that which was comparatively dormant. The operation for castration is very simple. An incision, of from one to two inches in length, is made down along the spermatic cord, commencing above, immediately below the external ring. The cord is dissected out, and secured between the finger and thumb of the left hand, before it is divided across. This is done to prevent its retraction into the canal before the spermatic artery is tied. The epididymic branch, if produced so high from the trunk, should be tied also, and the cord then be permitted to retract. When this part of the operation is completed, the scrotum and its membranes are laid open, and the testicle rapidly dissected out, care being taken to avoid the septum scroti, by which the other testicle would be exposed. The wound should be united by sutures.

For CANCER SCROTI, *see* TUMORS.

ON CATHETERISM.

It is impossible to teach the introduction of the catheter by the employment of words, or to convey the impression made in the operation, by any description, however correct and however elabo-

rate. The actual and repeated contact of the instrument with the living urethra is the only foundation on which skill can be built, and confidence acquired. Description may lead to the prevention of injury, but as there is no royal road to experience, so the most perfect description can but facilitate the progress of inquiry. It may point out difficulties, but cannot supersede them. And so far description may be useful in reference to the subject of catheterism.

Among the minor operations in surgery, not one marks the dexterous surgeon more pre-eminently than that in which an instrument is passed freely and without pain into the bladder; while, on the other hand, considering dexterity of manipulation as the exception, and the want of it the rule, if we take the entire body of the profession as the field of observation, there is perhaps no operation in the whole range of surgery, the negligent performance of which is the source of more abundant evil than this. This evil result is founded not so much on the want of knowledge, as on that of delicacy of manipulation. Perhaps I ought to qualify this assertion, by placing the frequency of injury to ignorance of the degree of resistance which the lining membrane of the urethra is competent to sustain without damage to its structure.

In the introduction of instruments into the bladder, *force* is rarely justifiable; but it may be asked, what is force? how can we determine the degree to be employed without injury to the structure of the canal? because what is called force by one man, another would employ in mistaken security. As a general rule, *the instrument should take its own direction, and pass into the bladder with little more than its own weight.* But this direction ought to be dictated by the natural curve of the urethra. From the moment we begin to employ force, we are striving to adapt the urethra to the false movements of the catheter, and hence injury by rupture of the membrane.

The natural curve of the urethra is much less in degree than that of the instruments generally employed. Still there is a curve, and the catheter should be adapted to it; in passing a straight instrument into the bladder, we do violence to the form of the canal. This curve is placed at the junction of the pelvic portion of the urethra, with the external or perineal; that is to say, low down in the perineum. The functions of the penis and the position of the bladder combine to render this curve a form of necessity. The unpractised surgeon should always bear in mind that the lower surface of the canal is extensible in its structure, while the upper surface is firm

and far less yielding, and hence the greater frequency of injury to the lower than the upper. The point at which the urethra enters the pelvis, in passing through the triangular ligament, is very low down and close to the rectum. The common fault in young operators is founded on miscalculation of this fact. Sufficient allowance is not made for the depth of the symphysis pubis from above downwards. The point of the instrument should be carried down nearly to the bottom of the perineum, before it is turned upwards into the bladder. The first and common error is caused by the attempt to depress the handle of the catheter before it has reached what I may term the angle of the canal. The point is thus pushed against the triangular ligament, above the urethra, or even against the bone. In endeavoring to avoid this evil, we fall into the opposite, and the result is rupture below or at the side. The success of one man over another is due less to his dexterity of hand than to his obedience to the rule that teaches us, while introducing an instrument along a healthy urethra, *to avoid resistance.* In a healthy urethra it is easier to pass a moderately large than a small catheter, because the large instrument distends and opens the canal more fully as it passes, whereas a small instrument is liable to push the membrane before it into a fold, not to catch in the lacunæ, which is impossible. In introducing the catheter, either the upright or the semi-recumbent position is most favorable. If in the upright, the patient should stand at the distance of some inches from the wall, and lean backwards against it. The penis should be grasped between the thumb and index finger of the left hand, about half way down the organ, and a catheter of a moderate curve introduced.

Whether the convexity of the instrument be directed to the abdomen, or vice-versa, is of no moment. The advantage of this position arises from the fact of its giving a greater facility for carrying the point down into the perineum, before the instrument is turned. But the same end may be obtained when holding the catheter with a large curve, with its concavity towards the abdomen, provided the handle of the instrument be kept close to the left groin, in the hollow of which it may almost be said to lie; while, if an instrument be used with a slight curve, the handle should be kept at an increasing distance from the abdomen. If the first position be adopted, the catheter having reached the bottom of the perineum, must be turned round in a half circle, to bring the concavity upwards towards the abdomen; and this movement is not always safe, because

the point, unless the instrument be held very steadily, will revolve in a small circle, instead of turning on its own axis. The difference, in fact, between the two modes, consists in this; that in the first described, the operation is divided into two stages, each corresponding with the two directions of the canal; while, in the second, the curve of the urethra being lessened by the act of extending the penis forwards, the instrument passes along it by one continuous movement into the bladder. In the act of introducing the instrument into the orifice of the canal, the handle should lie across the left thigh, and then, being raised a little towards the groin, passed down into the perineum, and may still be continued in this oblique position, almost until it enters the bladder, when it will naturally assume the mesial line. This rule will always vary according to the curve employed. In a healthy urethra a degree of pressure equal to the weight of a few ounces, is sufficient to effect the required object.

On Catheterism in Cases of false Openings in the Urethra.

Rupture of the urethra is the frequent product of violence exerted in the attempt to reach the bladder, and, for the most part, presupposes disease of some extent. This disease is almost invariably situated between the bulb and the prostate gland, known under the name of the membranous part of the canal. Here resistance is first felt by the operator, by whom it is attempted to be overcome by force, and the result, in unskilful hands, is rupture. The instrument passes on the outside of the mucous membrane, and, if still urged forwards, it takes the direction of the cellular membrane, between the bladder and rectum. It is somewhat remarkable how little irritation is sustained to the constitution by the occurrence of this accident. Blood may escape freely at the time, but the urine flows as before, without benefit from the operation, or serious injury from the accident.

The wounds in the urethra are almost invariably made on the sides or lower part of the canal, rarely or never above. When the catheter, or other instrument used, has once passed into them, it is very liable to follow that course invariably, unless especially avoided; and to effect this object, the penis should be drawn forwards upon the instrument with some force, great care being taken to keep the point of the catheter pressed against the upper surface of the mem-

brane, and to ascertain that the handle occupies the exact centre, passing at right angles to the abdomen. So long as the handle lies straight, the point will occupy the canal. As soon as it leaves the urethra, the handle will slope a little to one side, and the slightest obliquity in the handle marks considerable deviation in the point of the instrument. Moreover, it will be found that the point cannot be made to rotate with any approach to freedom; and especially so in the direction which tends to remove the obliquity, and to restore the instrument to its straight direction.

Under these circumstances the instrument should be withdrawn, and one, two, or three weeks allowed to elapse. A metallic bougie may, perhaps, be used on the next occasion, having a different curve.

If the surgeon has ascertained the nature of the case, he has also learnt the position and the direction of the false opening; and this he should carefully avoid. He may find it convenient to pass the instrument with his left hand, and in all cases of ruptured urethra to use a large instead of a small catheter. All instruments employed in exploring the canal should be *short in the shaft*, and fixed into a firm handle. Little more than two-thirds of the length of the old catheter will suffice for the length required. This remark, however, applies rather to the metallic bougie than to the catheter.

I am quite persuaded that we often refer to stricture what should be termed a false passage; the cases in which the point of the instrument is obstructed by the triangular ligament. Here the obliquity of the position of the handle in relation to the abdomen is a frequent attendant on the attempt to reach the bladder. The point is not locked, as though held by a stricture, but remains more or less free; and yet a false passage will occasionally bite the catheter, or hold still more forcibly a wax bougie. The first case that occurred to me, and appears to justify my opinion as to our liability to err on this subject, was that of a gentleman under my care for supposed stricture. I could never succeed in passing an instrument into his bladder; whenever the slightest degree of force was employed, an attack of fever followed. Weeks and months elapsed, and I made no advance. I held consultations with many eminent surgeons, all of whom, equally with myself, failed, but recommended perseverance in the attempt. He had been under my charge for nine months, when, on one occasion, having adopted a shorter metallic bougie than that I had been accustomed to use, suggested to me by Sir B. Brodie, the instrument (No. 7) passed immediately, and

without pain or effort, into the bladder, to the astonishment of my patient, and still more of my own. The success was unequivocal; the instrument passed up to the shoulders, and moved freely in all directions within the bladder. This feat I repeated on the following day; and from that date, neither I nor any other man has succeeded in passing an instrument beyond the original place of obstruction.

The second case was that of a Capt. A., whom I had treated for stricture, in conjunction with Mr. Wiblin of Southamptom, a very excellent surgeon, and thoroughly competent to such cases. Neither he nor I had been able to reach the bladder. The instruments employed by me, whether wax or metal, passed down into the perineum, and then stopped. Capt. A. was daily expecting an appointment abroad, and his continued suffering was not unlikely to mar his prospects in life. His water passed tolerably freely, but he was subject to attacks of spasm, and pain in making water; and these attacks had, by repetition, made some inroads on his general health. One morning I said to him jocosely, "Capt. A., I am resolved to pass this piece of metal into your bladder to-day," and by some accident I did so. I then withdrew the bougie, and assured myself that I had the power of repeating the attempt with the same success. On the following day I passed a large catheter into his bladder, retained it there for some forty-eight hours; and from that hour he has had no symptom of disease.

On Catheterism in Cases of enlarged Prostate.

Retention of urine from enlargement of the third lobe, as Sir Everard Home called it, of the prostate gland, may be recognized without the aid of an instrument. It occurs in advancing, and generally in advanced age. It is accompanied by frequent and incomplete micturition; the desire continues, but the stream is arrested. This occurs twice, thrice, or yet more frequently, during the night. The frequency of micturition has been increasing for years. This condition of the urinary organs is quite unconnected with a venereal origin. Many persons, when first resorting to surgical aid, have never seen a catheter. The stream of urine is too large to pass in such form of stricture as is competent to produce retention. The urine is generally ammoniacal, with flakes of a flocculent appearance floating in it.

Enlargement of the gland can be detected on examination by the

rectum; but we cannot infer the degree of enlargement of the lobe in the bladder by that of the body of the gland.

It often happens that the bulk of the third lobe is much larger in proportion than the body of the gland, or the size of one lateral lobe may exceed that of the other.

In order to pass an instrument to the greatest advantage, the patient should be got out of bed, and placed either against the wall of his room, or in a sitting posture, on the edge of the bed, leaning back against a chair, turned over and covered with pillows. Many a good manipulator has failed by attempting the operation on the patient while lying in bed. He should sit perfectly straight, with his legs asunder, as far over the edge of the bed as possible. A good-sized silver catheter may be used, No. 7, 8, or even 9, and passed down to the prostate gland. In order to avoid this obstacle, Mr. Hey advised the employment of a flexible gum catheter, the point of which rises when the wire within it is withdrawn. Mr. Hey advises that this expedient be applied to the instrument on entering the bladder, for the purpose of raising its point over the enlarged process of the gland. The idea is ingenious, but rarely practicable: for it will be found that the catheter is too fixed in its position to yield to the influence of the wire while retracting it. It is very rarely that I have failed, on pressing the point of the catheter against the obstacle, having previously convinced myself that the instrument is really in contact with it. The pressure should be firm, steady, and increasing. Should pressure fail, the finger should be introduced into the rectum, and its point directed upwards to the instrument, against which pressure should be made in the vertical direction. In the course of from two to five minutes, the obstacle will give way, and the catheter enter the bladder. When the contents are evacuated, the instrument may be withdrawn, in the belief that the next introduction will be attended with less difficulty.

These symptoms generally, though by no means necessarily, return in the course of time. I have known several examples of years passing without relapse. Permanent benefit may be obtained by the employment of pressure against the enlarged growth. This end may be effected by employing a catheter not less than No. 8 in size, with a round curve, and convex to its extremity, fixed vertically in the bladder, while the patient lies horizontally in bed, by attaching to the shoulders of the instrument the weight of a few

ounces, or indeed as much as can be borne without pain. The catheter employed for this purpose should possess a continuous curve, in order that the convexity of the instrument should rest against the morbid growth.

The principle on which the large prostatic catheter, as it is termed, acts, is by stretching the urethra in front of the prostate longitudinally, and permitting that part of the instrument which occupies it, to be depressed for the purpose of elevating the point when at the neck of the bladder. Its employment is occasionally successful, but I place greater reliance on the efficacy of firm pressure against the obstructing cause, with the conjoint force exerted upon the catheter by the finger in the rectum.

CHAPTER XVII.

OPERATIONS ON THE MALE PERINEUM, AND ABOUT THE ANUS.

VARIETIES OF DISEASE.—ABSCESS INVOLVING THE URETHRA.—EXTRAVASATION OF URINE.—OPERATION REQUIRED IN STRICTURE.—OPERATION REQUIRED IN FALSE PASSAGES.—RUPTURED URETHRA.—PUNCTURE OF THE BLADDER.—PUNCTURE THROUGH THE ABDOMEN.—PUNCTURE THROUGH THE RECTUM.—FISTULA IN PERINEO.—OPERATIONS ABOUT THE ANUS.—HEMORRHOIDS.—FISTULA IN ANO.

THERE is no part of the body more fruitful of disease than the region of the male perineum. Common abscess, stricture, causing retention of urine, extravasation of urine, extravasation of blood, with rupture of the urethra, fistula in perineo and in ano, abscess of the prostate gland, cancer scroti, and stone in the bladder—all demand the employment of the knife. Under the head of Lithotomy I have sufficiently described the anatomy of this region to render further reference to that subject unnecessary; I therefore proceed at once to the subject of abscess, which often becomes, in this region, an important disease.

This disease is often connected with a morbid state of the canal of the urethra, but it occurs in younger persons, independently of it. It appears in the form of a rounded hard swelling, occurring anywhere between the bulb and the orifice of the anus, sometimes attended with pain, often by a sense of weight only. Its depth, its duration, and size, will enable us to judge whether it belongs to the class of simple abscess, occurring in the subcutaneous tissue of that region; or whether, being the product of a local irritation caused by disease in the urethra, it involves deeper-seated parts, the urethra itself included. If the former, it will pass through the ordinary stages of abscess after puncture, should that be required; if the latter, the progress of the disease will be slow and the tumor deeper seated; we shall obtain evidence of stricture and of instruments having been passed. In the former case, the calibre of the

canal is unaffected, and micturition may be natural; in the latter, the canal may be compressed, and the act of micturition difficult.

When abscess of the perineum is the result of irritation in the urethra, the product of disease, the sac will usually communicate directly with the urethra, and urine will follow the puncture, either immediately or at any subsequent effort at micturition.

I know of no medical agency competent to repress the necessary advance of a suppurating tumor, either in this region or in any other. The progress onwards, under all circumstances, should be encouraged by the administration of bark, wine, and good diet, and the abscess opened as soon as matter is felt, or believed to exist.

OPERATION FOR EXTRAVASATION OF URINE.

This operation is generally required in advanced life in old cases of urethral disease. The probable cause in such cases is ulceration of the urethra, and the evil is increased by the straining efforts required for the expulsion of the contents of the bladder. It may also occur in persons of younger age, as the consequence of rupture of the urethra from accident. But this case is essentially different from that arising from neglected disease in the canal. There is a good deal of mystery yet unexplained, or at least of uncertainty in the source of this disease, and I am inclined to think that we not infrequently confound the existence of deep-seated abscess with extravasation. In a case of stricture advancing slowly under treatment, the progress of the case is sometimes arrested by an attack of retention of urine, accompanied by symptoms of a typhoid character, hot skin, dry and black tongue, delirium, &c. In such cases the experienced surgeon immediately looks to the perineum as the seat of injury. If the attack be recent, it is possible that the local symptoms of fluctuation may be very obscure, or even imperceptible. But more commonly a slight degree of distension of the perineum, accompanied by more or less tenderness on pressure, confirms his impression of the presence of fluid. In other and more advanced cases, the distension is manifest, indicated by the roundness and prominence of this region.

In consequence of the dense nature of the structure termed the perineal fascia, the fluid extends forwards, towards the scrotum and groins. The cellular tissue of the scrotum becomes quickly infiltrated, and the infiltrating fluid advances towards the inguinal

region, and thence up the sides of the trunk. Congestion of the vessels of the skin accompanies its progress in every part of the trunk, and in one case which I attended, advanced as high as each axilla. I have repeatedly seen great local distension of perineum, scrotum, and penis, accompanied by retention of urine, and symptoms of typhoid fever, called extravasation of urine, in which no evidence was obtainable of injury to the urethra. In all these cases the urethra, indeed, is opened from the perineum by the operator, but, I imagine, without fully calculating the necessity for such addition to the operation. The fetor of the pus discharged on exposing the cavity of the abscess, is sufficiently potent to set at naught any evidence as to the presence of urine; and I think we often take it for granted that urine is present, when the evidence of its presence is inconclusive. When urine is largely infiltrated into the cellular tissue, the character of the disease is apparent and unmistakeable. The extent of the disease is greater, it proceeds more rapidly, the early symptoms are not so severe, the latter symptoms more so. Destruction follows in its train, and death follows, without early relief. Incisions into the scrotum and penis are followed by the exudation of a fluid, having a distinctly urinous smell, and neither the distension of, nor the fœtor from, the perineum is so great as in abscess.

In puncturing abscess of the perineum, there is no necessity to pay much respect to the anatomy of the region. A long, sharp-pointed knife may be introduced anywhere near the centre of the perineum, and an incision, from one to two inches, made downwards and outwards towards the tuber ischii. The depth of the incision should be regulated by the flow of matter: if the discharge be free, and nothing but fetid pus escape, we have done all that is required, as far as relates to the perineum. The scrotum also may require a free incision, for, if involved in the irritation of abscess, it will swell to a great size, while its low organization affords no prospect of relief equal to that from free divisions by the knife.

In cases of infiltration of urine, the incisions must be yet more free and numerous. Cellular tissue cannot survive the contact of urine, and the only chance of its recovery is by making an outlet for the escape of this irritant, so fatal to its structure wherever it is infiltrated. When the incisions are completed, it is safer, with a view to prevent the extension of the disease, to pass a moderate-sized gum catheter into the bladder and to retain it. If this prevention

be adopted, I do not see that any advantage will accrue from opening the urethra, and still less so if the instrument pass without difficulty into the bladder, which may be facilitated, if necessary, by introducing the finger into the wound, and directing the catheter along the canal. Wherever it is necessary to make incisions into the cellular tissue, they should be made freely. There is great tendency to prostration, consequent on extravasation of urine, and great danger attends it, unless treated early.

OPERATION IN CASES OF STRICTURE, OR OF RUPTURED URETHRA.

This operation may be required in cases of obstinate stricture, with or without retention of urine in false passages, or in cases of ruptured urethra from accident, accompanied also by retention. In old stricture, the subject of much former treatment, the neighborhood of the canal in the perineum is generally consolidated by old deposition, perceptible on pressure. This hard deposition pervades the line of the canal for some inches in length. In such cases, the difficulty of passing instruments of a size sufficient to effect good service is often exceedingly difficult, although it may be perfectly true, that the canal is patent for urine passed in a fine stream from the bladder. Probably skill and long perseverance in the use of instruments for dilatation would eventually succeed in overcoming the evil, but the time required may be a serious obstacle to its prosecution. The health or the degree of suffering of the person may preclude the trial, and require the disease to be brought to an early crisis. The operation affords immediate relief, and should be resorted to on the above condition. But at the same time it must be acknowledged, that different degrees of dexterity in the use of the catheter will materially influence this necessity. Experience is indispensable to the just management of the case, a thorough knowledge, not of the particular case under treatment alone, but of urethral disease in general, the knowledge of the use of the instrument, the degree of force with which it may be urged, and the direction in which that force may be profitably employed. The only substitute for the experience, thoroughly obtainable by a few only, is to be found in the possession of tact and knowledge of anatomical structure; without these requisites we can form no positive gauge of the necessity of the operation.

In the case of false passages in the urethra, made by the hand of science, the operation for puncturing the urethra is occasionally, though not often, required, because there is no correspondence between the difficulty of passing a catheter or other instrument into the bladder, and that of the urine passing from it. We do not operate for the purpose of increasing the facility of introducing instruments into the bladder, but to increase that of the egress of urine from it. In these cases the calibre of the stream may be ample for all purposes of health, though not of convenience; and under such conditions there can be no urgent necessity for operating, indeed few persons would submit to it. When the difficulty of micturition is great, and the introduction of instruments is productive of so great irritation as to raise a commotion in the functions of the body, and to produce irritative fever, remittent or intermittent, then we are justified in having recourse to the use of the knife.

The perineum is liable to injury from accident, such as violent blows in riding, or in falling across railings or pieces of timber, with the thighs separated. Such accidents are often very dangerous from the amount of injury done.

The appearance presented by the perineum is that of great discoloration, and of distension, caused by extravasated blood, extending forwards towards the scrotum and infiltrated into its tissue. Every attempt at micturition fails, from causes not very easy to explain.

The common explanation, which refers this difficulty to pressure on the canal of the urethra by the extravasated blood, may be sufficient, but it is by no means satisfactory to my own mind. I would rather refer it to paralysis of the bladder, caused by the shock, in which volition fails to excite the abdominal muscles to action, for it is through the agency of these muscles of animal life that the organic fibres of the bladder are excited to action. There would appear a local consciousness of mischief, a condition which explains the difficulty of micturition, by referring it to a cause allied to that which occasions constipation in peritonitis or other inflammatory conditions of the abdominal cavity. Whatever be the explanation, the fact is positive. Under circumstances of unusual violence, the pelvic bones may be split asunder. This fracture may take place by the side of the symphysis, or across the rami. In one case the fracture passed into the acetabulum, and the man eventually died of inflammation of the hip-joint. The penis may be rent asunder, or one crus torn from its origin from the ramus. The urethra is

usually torn across, and the two ends separated from each other by intervening blood. Every attempt to pass an instrument into the bladder is unsuccessful, and we cut into the perineum.

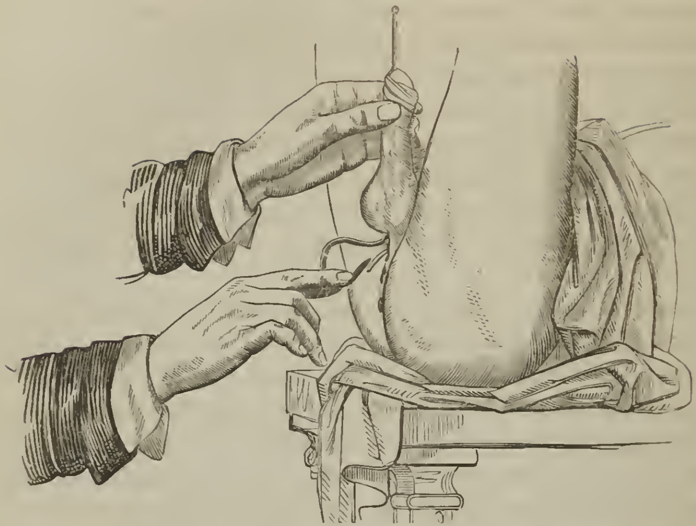
Whether for the purpose of relieving the bladder, in the case of retention of urine dependent on stricture, or on rupture of the urethra, it is requisite that we dissect down upon the canal in the perineum, and pass a gum catheter onwards into the bladder.

In the case of *stricture*, the patient must be placed, as indeed in that of all operations on the perineum, in the attitude required for stone.

A silver catheter of moderate size should be passed into the urethra, and held against the stricture, if it occupy its usual seat, viz., in the membranous part of the canal. If the catheter stop at any point short of the perineum, its introduction is useless, and it may be withdrawn. An incision of two inches in length should be made in the well-known line of the first incision for stone, passing deeply into the substance. The operator then dissects more deeply towards the centre of the perineum, but keeping upwards, and endeavors to open the canal, beyond the bulb and about three-quarters of an inch below the arch of the pubes. He should now employ a director or a straight piece of gum catheter, with which he should endeavor to find the orifice of the canal, and by careful manipulation he will find it sooner or later. The entrance of the catheter is immediately followed by a rush of urine, and the patient is at ease. This is the first part of the operation, and the most difficult of execution; the most important object is attained, viz., that of ascertaining the patency of the canal beyond the stricture, and the relief of the distended bladder.

The next consideration relates to the condition of the canal above the perineum, and this must now be opened by the employment, if necessary, of force sufficient to bring the metallic instrument employed out through the wound in the perineum, where the two instruments will meet. The silver catheter should be withdrawn, and an elastic gum instrument introduced in its stead, which being brought out of the wound for several inches of its length, should be then bent, and the point turned backwards, and passed along the remaining part of the canal into the bladder, as the former catheter is withdrawn. If the last portion of the canal has been originally discovered without difficulty, it may not be necessary to bring the point of the gum or

Fig. 73.



permanent catheter out through the wound, but we may make the attempt to pass it at once into the bladder, guided by the forefinger of the right hand. When the instrument has reached the bladder, the end of the operation is answered, and the rest of the treatment must be left to nature.

The catheter should be fastened in the canal, by means of a strong silk thread tied around it, close to the orifice of the urethra, and the two ends carried backwards. These ends may be fixed by plaster placed rather loosely around the penis; or may be tied around the root of the penis and scrotum; or may be fixed to a bandage applied around the abdomen. In the latter case, four threads, of a foot to eighteen inches in length, will be required; two passing forwards, and two backwards, attached to the circular abdominal bandage, with a degree of tension sufficiently great to prevent the escape of the catheter from the canal, or even that of the eye of the instrument from the bladder. Before tying it, the catheter should be pushed nearly up to its shoulders into the canal. In the course of a few days, the urethra will mould itself upon the instrument, which should be withdrawn and changed every four or five days. All that is required by the wound is that it be kept clean. The urine should be allowed to trickle away as it is secreted for some days, and then, in the second catheter, a wooden plug may be introduced,

and the urine permitted to flow off at intervals of an hour or two, or even longer.

In cases of *retention of urine, arising from ruptured urethra*, from the result of violence, and accompanied by much extravasation of blood, we adopt the first incision of the last operation, and proceed onwards, as before. On introducing the finger, it is often found to pass into a cavity filled with coagulated blood, and we may feel the ramus of the pubes denuded to the extent of an inch or two of its length. The crus penis may be separated, or the bone broken. It is necessary to remove the coagulum. This is effected by the finger, and partly by the introduction of small pieces of sponge, which should be employed to wipe out the cavity, and free it from the extravasated blood. A gum catheter should then be passed through the penis from above, and the attempt made to pass it onwards, aided by the finger in the wound. Every direction, and every curve of the instrument, made by altering the form of the wire, should be tried, but without force. The patient should be desired to make an attempt to pass water, and the escape of a few drops may indicate the situation of the posterior opening of the canal, and thus we may succeed in discovering it. Sometimes, in case of failure in the attempt to micturate, this object may be obtained by pressure of the closed hand on the hypogastric region. Should our efforts fail, the patient should be put into a warm bath, by which, probably, the function will be sufficiently restored to enable us, by pressure and by the aid of a good light, to ascertain the precise locality of the concealed orifice. If the difficulty yet continue, after the expiration of some hours, and the increasing size of the organ warn the surgeon of the necessity of affording relief, we have no alternative but that of taking the direction of the canal, and passing a small metallic catheter forcibly into the bladder. For this purpose, the patient should be placed on the middle of his back, and lie as symmetrically as possible; the arch of the pubes should be traced by the finger, and the point fixed on, which corresponds with the usual exit of the urethra from the pelvis; one finger should be introduced into the rectum, and the last joint curved upwards towards the urethra, immediately behind the sphincter, to guide the point of the catheter. The urethra in health runs about a quarter to half an inch above the finger so pressed, and the presence of an instrument in the canal is always perceptible. •

If the natural channel be discovered without the necessity of

having recourse to this unfortunate alternative, the after-treatment will correspond with that given in puncture for stricture. If the instrument be forced through an abnormal opening, the necessities of the patient will require its early, perhaps its immediate, removal, and we can only hope that the bladder, being now relieved from its contents, will regain its functions before it becomes again distended.

There are three directions through which the bladder is accessible by puncture in cases of retention of urine from stricture. The first, and that generally resorted to, is that already described, through the perineum. The second is made by puncture through the abdominal parietes, in the hypogastric region, and the third through the rectum. Of these, that through the perineum is the safest, but generally, perhaps, the most difficult of execution. But the question of safety to the patient is paramount to any other that can be raised, and it is therefore selected on all ordinary occasions. It may be useful to point out the class of cases in which one or the other mode of proceeding should be preferred. *The operation above the os pubis* may be recommended for occasional adoption, on the authority of Mr. Abernethy, who gave to it a preference over either of the other forms, and has many times expressed to me his conviction of the advantages afforded by its selection. Its merits appear chiefly to consist in the facility of its performance, and the instant and certain relief afforded by it, and it should be selected in cases of extensive disease in the urethra or perineum, and occasionally in very enlarged prostate gland. But the necessity of opening into the cavity of the abdomen, or making a puncture through the abdominal walls, when the perineum affords a fair field for the operation, must be very rare; and to select this in preference to the perineal region, without positive indications, is to prefer a greater danger to a lesser one. In puncturing the bladder above the os pubis, the trocar passes through two layers of peritoneum, viz., the layer that lines the abdominal muscles, and that which forms the external coat of the bladder. I am aware that this opinion is not a general one, for it is more consonant with common belief that the peritoneum is detached from the os pubis and from the bladder, in cases of great distension of this organ. But in favor of my own opinion I would point to the wonderful extensibility of the serous membrane in hernia, and ask the physiologist whether it is possible that because the bladder is unnaturally, or rather unusually distended, nature would deprive it of the most extensible of its coats. I believe not, and on the

contrary, I feel strongly the truth of my assertion, that the peritoneum is unaltered in its relations to both the bladder and the abdominal parietes. The fact of the absence of peritonitis after puncture of the bladder above the os pubis is no argument against this view of the unaltered relations of the peritoneum, for, as I have elsewhere said, I do not concur in the generally entertained opinion of the great liability to inflammation of this membrane.

All that is required for the operation itself is a simple puncture through the abdominal walls, immediately above the os pubis. I do not consider a previous incision by the knife by any means requisite, but I think, on the contrary, this practice is to be objected to. The direction of the trocar is of moment. If the puncture be made too vertical, the instrument may pass between the bladder and the os pubis, and this occurrence I have borne witness to. If, on the contrary, it be made too horizontally backwards, although we may with certainty strike the bladder and evacuate its contents, yet as the organ contracts, the coats will hang on the canula, which will prevent its entire return into the pelvis, when emptied. Indeed, the organ cannot be fully emptied on such terms. This error I have also seen. The direction that the trocar should take is at about an angle of 45°, with the horizontal line backwards, carrying it downwards and backwards, towards the axis of the pelvis. Before the fluid is entirely evacuated, a piece of gum catheter, as large as the canula will admit, should be introduced through it, and the canula withdrawn. This instrument, being provided with a wooden plug, must be retained throughout the treatment, or until the natural passage is re-established. About three inches of the canula, or rather more than less, should be retained in the wound. This operation was performed on the late Mr. Bartleman, who retained the instrument in his bladder for some two years before his death. He travelled about the country, with the instrument in his bladder, and without much pain or inconvenience.

The bladder is occasionally punctured through the rectum by means of a curved trocar, directed on the finger, which is retracted within the canula during its introduction. In performing this operation, care must be taken to make the puncture in the mesial line, lest the vasa deferentia be wounded. The objection to this form of operation for retention of urine consists in the difficulty of retaining the instrument, and not less that of our ability to control the opening between the rectum and bladder, on removing the wax bougie, should

it show an indisposition to heal. As far as my observation goes on the merits of this operation, which, however, has not been very great, it constitutes the least advisable of the three operations, undertaken for relieving the bladder, in retention of urine.

FISTULA IN PERINEO.

Unnatural openings into the urethra occasionally occur, following extravasation of urine or abscess, through which the urine flows in every act of micturition. There may exist one of these openings, or many. When produced by extravasation of urine, they may be numerous. In one case that I treated, there were as many as six or seven in number, occupying the perineum, groins, and hypogastric region. This case was that of obstinate stricture, and it occurred in the practice of Mr. Abernethy, but was afterwards consigned to my care. The injury sustained to the urethra by the presence of these openings is very great. The canal becomes narrowed in front of them, and after a term of years is so contracted as to defy treatment by dilatation. Abscesses form in the neighborhood of any part of the track of the urethra, and burst into the canal. I have recently had a case of this kind, in which the abscess formed in front of the os pubis, and burrowed down to the urethra in the perineum.

Little assistance can be afforded in such forms of disease by the aid of operative surgery; at least, until the first and most important indication is fulfilled, viz., that of rendering the entire canal of the urethra patent. This canal must occupy the first and exclusive care of the surgeon; for just in proportion as the above end is attained, will the openings heal. It is sometimes advisable to plug the sinuses with lint, which acts rather as a stimulant than as a mechanical impediment to the flow of urine through them. It is very often necessary to confine the person to bed, and to leave an elastic gum catheter in the bladder for some days, through which the water will entirely flow. Conjointly with this treatment, the efficacy of general and elastic pressure is very serviceable, and its application for many hours in the day, or even throughout the twenty-four hours, if bearable, will accelerate recovery.

A case occurred to me recently, in a small hospital to which I am attached, which illustrates this principle. I was requested to see a woman with several fistulæ about the anus and perineum. These sinuses were large, and communicated with the rectum, and whenever

the bowels were relaxed, their contents passed freely through them in all directions. On examining the rectum, I found it so much closed as to render the introduction of the finger exceedingly difficult and painful. The repeated use of the rectum bougie, which was ordered to be retained in the intestine for an hour or two at a time, resulted in the closure of all the sinuses, and in the entire re-establishment of her health, locally and constitutionally.

OPERATIONS ABOUT THE ANUS.—HÆMORRHOIDS.

Hæmorrhoids may require removal when large, painful, or intractable to other treatment. Whether external, or within the verge of the sphincter, these cellulo-vascular growths are almost always amenable to well-applied pressure, the most efficient agent of which is that of the short metallic bougie. This instrument, about two inches in length, should be introduced into the rectum, and there retained in the sitting posture of the person, as long as convenient at each time, or a candle, or rectum bougie should be introduced daily, to the extent of two or three inches. A round fold of linen, of about the size of a towel, will be found a useful addition, if placed on the chair or seat, and employed at all times for external pressure, and for which purpose an elastic spring, terminating in a pad, placed over the anus, is sometimes requisite, to which the injection of cold alum solution may be added once a day. As an aperient, when required, a dram or more of castor oil, with five to seven drops of tinct. opii each morning, will often afford great relief.

I am satisfied that these measures will generally render the resort to the operation of removal, unnecessary; for, although they may fail to remove the morbid growth, which has been a source of so great pain and inconvenience, and often of loss of blood; yet perseverance in their use will so far reduce the size and activity of the growths as to supersede the employment of more active measures.

Cases are recorded in which danger from hemorrhage, and even death, have followed the removal of hæmorrhoids by the knife; and the bleeding may be formidable, if the operation be undertaken without due regard to the irritable nature of the disease. If the pile be firm, and not apparently congested, it will not bleed to any injurious degree; whereas, if full and rounded, if apparently distended with blood, as though strangulated, and painful on pressure, then some additional care is required. This growth may be removed

either by the knife or by ligature. The objection to the knife is founded on the liability to hemorrhage; that to the ligature on its pain and inconvenience. I usually combine the two operations, and by that means, I think, I avoid the evils of both.

The mode I allude to consists in passing a thin copper or iron wire in the form of a loop, made through a double canula around the root of the growth, and strangulating it by drawing the wire tight. This being accomplished, the canula may be retained in this situation for any length of time, from half an hour to an hour or more, and the pile may then be removed with the knife or a pair of scissors; and, as it is far easier to arrest bleeding at the commencement than when established, so, should bleeding occur, immediate pressure should be applied by the finger or by pads of lint. Serious hemorrhage, however, is a rare occurrence.

FISTULA IN ANO.

A fistula may be detected by the presence of discharge on the patient's linen, and pain on going to stool, accompanied by the orifice of a sinus at the side of the rectum. Sometimes the sinus is internal only, the orifice of which is incompletely formed, but is indicated by a red point on the skin, at a greater or less distance from the orifice of the anus. At other times the sinus has no communication with the rectum. This disease is often associated with pulmonary disease, and it behoves the surgeon always to make inquiry into the condition of the respiratory organs before he proceeds to attempt the cure of fistula in ano. This end may be attained by means of a thread passed through the fistula, when open, at both extremities, and tied loosely in a knot. The thread may be allowed to remain for some days, or even longer if the sinus do not appear conscious of its presence. When removed, the canal will heal rapidly, particularly under the administration of bark. When the fistula is complete, and the knife is to be rendered the agent of cure, a director is passed into the sinus and forced upwards to the rectum, upon which a probe-pointed bistoury is conveyed; the index finger, sufficiently greased, receives the probe point within the gut, and the bistoury and finger are withdrawn together. This act is facilitated by the integuments of the buttock being drawn tightly outwards by an assistant at the moment of withdrawing the knife, by the application of both his hands.

When the inner orifice is incomplete, a flat and smooth piece of

soft wood should be used instead of the finger, and introduced into the rectum. A sharp-pointed bistoury is employed instead of the probe-pointed instrument. The point of the bistoury is passed through the mucous membrane and fixed in the wood, and the two are then withdrawn. These operations at the orifice of the anus should be performed on the person, while kneeling on a bed or couch, with the back depressed.

It is almost unnecessary to say, that whatever is placed between the sinus and the rectum must be divided, whether the orifice of the sinus be upon, or on the outer side of the sphincter ani.

In dressing the wound, up to the period of its entire closure, great care should be taken to prevent union of its sides.

CHAPTER XVIII.

ON THE OPERATIONS OF LITHOTOMY AND LITHOTRITY.

INDISPENSABILITY OF RETAINING BOTH OPERATIONS.—CONDITIONS REQUIRED FOR LITHOTRITY.—INDICATIONS DEMANDING THE CUTTING OPERATION.—SYMPTOMS OF STONE.—ON THE EMPLOYMENT OF THE SOUND.—OPERATION OF LITHOTRITY. — DIFFICULTIES ATTENDANT UPON IT.—CONSEQUENCES. — LITHOTOMY. — EVIDENCE OF STONE IMPERATIVE.—INSTRUMENTS EMPLOYED. — STAFF.—GORGET.—FORCEPS. — OPERATION.—SECTION OF PROSTATE.—ENLARGED PROSTATE.—AFTER TREATMENT.

I do not propose, in the following chapter, to carry the reader through all the elaborate detail of the history and progressive stages, up to the present era, of this important and interesting operation. I deal with the operation, not with its history, nor its progress. No one subject in surgery has occupied so large a space in the records of the past as this; and in none has the ingenuity of surgeons been more largely taxed for the invention of means by which to lessen the danger of the operation of cutting into the bladder, or, within the last quarter of a century, to extract the stone from its cavity by lithotrity, without the aid of the knife.

In reference to the operation of lithotomy, it may be said to have reached its highest degree of perfection, determined by the success that attended it, at the early part of the present century, since which time, although the steps of the operation may have been somewhat smoothed and rendered easy, yet the proportion of recoveries stands much where it did at the date alluded to—at which it was no uncommon or unreasonable boast, by many of the leading hospital surgeons of London, that they had successfully treated from twelve to fifteen cases of stone consecutively, without the drawback of a single death.

The great feature in the history of the present century is the introduction of the operation of lithotrity, which has reduced the amount of cases in which the knife was resorted to; and if we

consider the multiplication of the London hospitals, and the progress of surgical science throughout the provinces, which has tended to lessen the centralizing influence of the metropolis, it is not surprising that the examples of this disease in any given hospital should be greatly reduced in number at the present period.

In estimating the value of one or other mode of ridding the patient of the stone, we must calculate the results negatively as well as positively. We cannot acquire a sufficient insight into the merits of lithotomy without we also apply our minds to the results of the rival method of cure; viz., that of breaking up the stone within the bladder by means of the lithotrite. One fact is obvious, that the operation of lithotomy must be retained by all practical surgeons, as indispensable to treatment in many cases in which the resort to the screw of the lithotrite is as impossible as though it had never been invented; while, on the other hand, the known facility by which, under favorable circumstances for the operation, a stone in the bladder may be broken to pieces, and entirely got away without pain or injury, or considerable suffering of any kind to the individual, gives such palpable superiority, on the score of security, to this mode of treatment over the former, that it would appear an unpardonable neglect of the interests of those consigned to our charge, to resort to the old operation. It is obvious, therefore, that of the two modes of proceeding neither can bé dispensed with, and the first duty of the surgeon, in any given case, is to determine which method is the more applicable, and more likely to meet all its necessities. If we were to select a case for the exhibition of the operation of lithotrity—and I take lithotrity as the rule, and the cutting operation as the exception, considering the simpler and the safer course to be that demanding the first consideration, and before the tribunal of which the case is to be first brought for trial—if we had the power of selecting a case especially suitable in all its bearings, we should require the following conditions: First, well-developed manhood. Second, a healthy and readily dilatable urethra. Third, a bladder free from irritation, and capable of retaining at least six ounces of urine, a condition which infers the absence of prostatic disease. Fourth, a tonic condition of the nervous system; and Fifth, the presence of a stone of such dimensions as to be readily embraced by the screw of the lithotrite.

But these conditions are rarely obtainable in perfection in any one

case, and it remains therefore to consider, and to canvass their relative value, in determining whether or not, in the aggregate of their presence, the operation of lithotrity shall be resorted to. And here let me observe, that such is my impression of the superior value of lithotrity, under circumstances favoring its employment, that I deem it sufficient evidence of the necessity of the cutting operation, only under such circumstances of the case as positively contra-indicate the breaking up of the stone. As I have above said, all cases are to be first canvassed by the appeal to lithotrity; if this appeal fail, the necessary alternative, the *pis-aller*, is the cutting operation.

But it is because these conditions cannot be invariably found in combination, that the old operation will be frequently resorted to by the most earnest advocates of lithotrity; and the entire of my argument goes to this extent, and no further, viz. that this (latter) operation, being less dangerous, and equally efficient as lithotomy, should in all suitable cases be selected. Let us consider these requisite conditions a little more in detail, with the addition of such collateral and incidental circumstances as may occur in individual cases.

First. Well developed manhood is indispensable to the use of the lithotrite. Our lithotrity instruments, unlike the instruments employed in cutting, and made suitable to all ages, are necessarily limited in size; because all their substance is required for strength, on the possession of which quality their safety and only utility depend. It is impossible to make a lithotrity screw of a size admissible into the bladder of a child, that would bear the force employed on it without danger of breaking in the bladder, therefore manhood is indispensable; the operation of cutting being the only operation permissible in the case of a child. Still this law admits of qualification; for I have no doubt but that the operation of lithotrity may be rendered available to boys as early as thirteen or fourteen years of age, by a reduction in the size of the adult lithotrite, and by careful dilatation of the urethra.

But even the manhood inferred by age requires healthy development of the genital organs, and most especially of the spongy body of the penis. If the glans be defective, or if any evidence appear along the track of the urethra, that nature has been sluggish in her formative power, then the sound alone can determine the question. If a full-sized sound pass readily into the bladder, that is all that is

required. In some cases, the introduction of any instrument is followed by severe rigors, forming on objection to lithotrity.

Second. A healthy and readily dilatable urethra. It is hardly necessary to say that the canal must be sufficiently large to admit of the passing of the requisite instruments, and these in relation to catheters in ordinary use, are of the largest size. A contracted state of the membranous portion of the canal is a frequent condition of the urethra in many persons, consequent on gonorrhœa, or its treatment, or both, or coupled with protracted gleet. Until this disease be removed, and the canal be rendered entirely patent to the instruments employed, no attempt can be made to break the stone. At the same time it must be recollected that this state of the canal almost equally precludes the resort to the knife by cutting, as it is impossible to introduce a staff into the bladder, to direct the course of the instrument. Any sized staff that can reach the bladder is admissible in lithotomy, in cases of necessity, as is evidenced by a case recently reported, under the charge of Mr. Syme, of Edinburgh, in which he employed an instrument much within the usual size.

Unless the seat of confirmed stricture of long standing, this diseased condition of the canal may be sufficiently removed by active treatment, to admit even of the introduction of the lithotrity forceps.

Third. A bladder free from irritation, and capable of retaining six or more ounces of urine. The degree of irritability of the bladder varies greatly in different examples of disease, dependent partly on the constitution of the individual, and partly on the composition of the stone. We occasionally meet with persons possessed of a morbid irritability of the bladder, who are unable to retain their urine under any circumstances of mental provocation, and who habitually void it, in health, with greater frequency than other persons.

In some constitutions the introduction of any instrument is followed by rigors, as has been remarked by Sir B. Brodie. Such symptoms would, so long as they continue, always contra-indicate the operation of lithotrity. Enlargement of the prostate gland would, of course, be fatal to lithotrity, not only from the mechanical obstruction to the employment of the lithotrite, but that its presence infers a condition of bladder which precludes its admission of a sufficient quantity of fluid to protect it from injury.

In at least an equal degree is the composition of the stone an occasional source of irritability. Calculi, composed of phosphatic

salts of secondary deposit, such as the triple phosphate, or the rare example of phosphate of lime calculus, almost necessarily infer disease of the bladder, and, of course, great irritability of the organ. In mulberry calculus (the oxalate of lime), the power of retaining the contents of the bladder is limited, from the mechanical form of the stone, presenting so many angular projections from its surface, which are supposed to be sources of irritation to the coats of the bladder contracting upon it. I say, supposed to be sources of irritation, because considerable doubts exist as to the truth of this received doctrine. Oxalate of lime calculi are occasionally unattended by pain, while in other examples considerable suffering is coexistent with the entire smoothness of surface of a stone of similar composition. When this irritation is great, and the calculus large of its kind, the bladder, consequent on its long intolerance of distension, has acquired a permanently contracted condition, which will not admit of the injection of the quantity of water at the time of the operation requisite for safety.

This condition of bladder is unfavorable for lithotrity, so long as it remains; but supposing all other symptoms favorable to that form of operation, this objectionable state of the bladder must be got rid of, by frequent and daily injections of warm water or decoction of poppy heads, which shall distend the organ gradually, under the sedative influence of opium, taken by the mouth or employed as a suppository; and as the distension of the bladder sufficient for the operation is not great, the difficulty may be removed by perseverance in this measure, the time required for which will, of course, hold some proportion to the past duration of its irritable state.

Fourth. A tonic or healthy condition of the nervous, and indeed of the entire system, is, of course, most desirable. Yet so far as a state of impaired health is attributable to the presence of stone, so far is its early removal indispensable to recovery. If a man's health suffer from the presence of stone in the bladder, it is obvious, as the focus of mischief, that the cause must be removed in order to effect his recovery, whether by cutting open the bladder or breaking up the stone while in it. No one would operate by either mode on a person suffering from other sources of illness than such as would be removed by the extraction of the stone. A tonic condition of the system, therefore, may be desirable, but is not always attainable; and when the want of it is dependent on the presence of stone, we

endeavor to patch up the constitution for the occasion, and select some opportune moment for the removal of the cause, but we devote ourselves more seriously to the re-establishment of the health of the person, when the cause is extraneous and foreign to the presence of stone in the bladder.

Fifth. The presence of stone of such moderate dimensions as to be readily received by the screw of the lithotrite.

If a stone be sufficiently large to give cause for inquiry as to its existence, it is not, I apprehend, too small to be caught by the lithotrite, employed with reasonable tact. If this difficulty be great, the attempt to place it within the grasp of the lithotomy forceps, will be equally so in the cutting operation, and nothing is gained, therefore, to the latter by the diminutive size of the stone. But a grave objection to lithotrity is obtained from the presence of a very large stone, and especially if, being of large dimensions, it be composed of the hard material of oxalate of lime. The stone may be so large in all its dimensions, as to be inadmissible between the blades of the lithotrite, when dilated to its fullest extent. Still the peculiar difficulties of a case must command additional resources, and increased powers in the instrument. The lithotrite is not weakened in its mechanism by its blades being made to separate more widely asunder than the instrument ordinarily used, though other objections to this change may be suggested, for the bladder may not be so distensible as to admit of this alteration in the instrument. In addition to a large stone, the bladder may, and probably will, not be found sufficiently dilatable to admit of the injection into it of the requisite quantity of warm water, and without it the operation cannot be undertaken with safety to the coats of the organ. Again, supposing the stone to be very large and barely admissible between the blades of the instrument, it may possess the additional disadvantage of being very hard in structure, and the process of breaking such a stone is a very protracted one, and would require many repetitions of the operation, and occupy many months.

The attempt to expand the lithotrite in a contracted bladder is a painful, sometimes a very painful addition to the patient's suffering, and the attempt to catch it must be made with the greatest delicacy and tact. On the other hand, the danger of the operation of lithotomy is greatly increased when the stone is very large, consequent on the greater than usual extent of the incision into the neck of the bladder. On the whole, we may infer, that in cases of large

stone, the objection, *cæteris paribus*, to its removal by the knife, are greater than to its being broken up by the lithotrite. This, of course, supposes that, although large, it is still capable of being grasped by the instrument. If this be impossible, there remains no alternative to the knife.

It has been stated, that unless contra-indicated by circumstances, the general treatment for stone by operation is that by lithotrity. But from the above remarks it is obvious that the exceptions are very numerous to its application. It is an impossible operation in childhood, and, except under the qualifications above alluded to, unsafe; even in early boyhood it cannot be resorted to: in stricture of the urethra: or in any morbid contraction of that canal; so long as the contraction continues, the difficulty of the operation is greatly increased: under circumstances of irritable bladder, with frequent micturition: it is objectionable in a stone of very large dimensions, and impracticable in a stone the diameter of which exceeds that of the instrument employed to crush it.

Suppose a case to occur in a young and healthy man, whose urethra is not disorganized by disease, whose bladder is capable of retaining its urinous contents for some hours before expulsion, and in whom the shortest diameter of the stone does not exceed fifteen lines, and that not composed of the firmest texture, we have as perfect conditions as we can desire for the operation of lithotrity.

The merit of the operation of lithotrity consists in the fact of its freeing a person from a serious and painful disease, more or less dangerous in its nature, by a simple and almost painless agency. Its demerits are not, however, inconsiderable or unimportant. It is often protracted, by the necessity of frequent repetition. It is sometimes painful in the execution, under the best management. It is occasionally followed by hemorrhage, protracted for many days, and under circumstances of the gentlest manipulation.

Particles and pieces of stone may become a source of difficulty, by lodging in the urethra, and producing retention of urine; inflammation and abscess may follow. In incipient disease of the kidney, that evil is very liable to gain ascendency during the period of treatment, caused by irritation, whether of the instrument or of the fractured stone when broken up in the bladder. Cases occur in which the crushing has been most successful, but where the escape of the detritus is very disproportionately small. Many days elapse, and the quantity collected will not fill half a thimble. Pain in the

bladder follows, increasing after every renewed introduction of the instrument. Inflammation of the organ destroys the patient, and examination discloses a sacculated bladder, into the diverticula of which the fragments of stone are collected. Such a case occurred to me last summer in St. Bartholomew's Hospital.

In a second case, I sounded a man for stone. The stone was very large, and was got within the blades of the lithotrity forceps with difficulty, but I made no attempt to break it: at the end of a fortnight I repeated the examination with great care. This operation was followed by pain in the bladder, intermittent fever, and he died in two months of diseased kidney. I broke a stone into fragments in a gentleman's bladder at one sitting. The operation, though performed with all gentleness, occasioned considerable suffering. Hemorrhage followed to a formidable degree. His bladder got clogged up by coagula and viscid mucus. Severe and painful spasm followed, as usual, in this train. The hemorrhage continued great for upwards of a week, and did not finally cease for three weeks, or longer, giving place to the discharge of large quantities of viscid and ropy mucus, produced from the inner lining of the bladder. Small fragments of stone continued to escape for many weeks afterwards, the sum total of which, however, bore a very small proportion to the size of the stone.

Chronic inflammation of the mucous membrane of the bladder is not a very uncommon result of the use of the lithotrite, indicated by the ropy adhesive mucus, or muco-purulent secretion above alluded to. This, although not in itself a serious symptom, betrays too much active irritation in the bladder to justify a repetition of the operation. But the strongest objection that can be urged against the operation of lithotrity is the difficulty of insuring the removal of every particle of stone from the bladder, any one of which, however small, is sufficient to form a nucleus of a new calculus. It is, indeed, exceedingly difficult to ascertain this fact, and when we compare the greater liability to the return of the disease within an interval of a year or two from the period of the operation of lithotrity, than in that of the cutting operation, we may reasonably refer the fact to the detention by the bladder of some particle or fragment that has remained behind. Still, supposing this view a correct one, it should only render us more vigilant in our efforts to effect the entire separation of every particle of the broken stone, by repeatedly washing out the bladder, injecting it to the fullest degree of distension compatible with the

reasonable endurance of pain by the affected person, and occasionally by careful and dexterous sounding.

The merits of lithotomy are apparent in the entire removal of the stone by one operation. It is in my opinion especially advisable, in all cases of stone in which the bladder is diseased, or even whenever it gives evidence of unusual irritability, whether from actual disease, or from a morbid susceptibility of its nervous system. Under these circumstances, it is desirable that the cause be at once removed, rather than the bladder be subjected to the repeated introduction of irritating instruments, the advantages derived from which are remote and uncertain, while the evil is immediate and positive.

The danger from the operation of lithotomy, especially in young children, when well performed, and when free from the unfavorable concomitants of an impaired state of health, impending liability to renal disease, unhealthy organs, and a stone of large dimensions, is comparatively small. But still there is danger, as evidenced by the proportion of deaths occurring from it, and this danger, whatever its amount, is not sufficiently met by the great advantages arising from the entire removal of the causa mali to justify any approach to an indiscriminate resort to it.

The average mortality in cases of lithotomy operated upon in England, is about three in twenty-three cases; this is the statistical report given by Mr. Crosse of Norwich, and is obtained from the report of seven hundred and four cases, operated on in the hospital and city of Norwich, and it corresponds with a similar average given by the late Mr. Liston, and other eminent surgeons. M. Lisfranc,* in reference to the mean mortality of cases operated on in Paris, gives the deaths to the recoveries as one in four; Dupuytren† one in five and a half.

Symptoms of Stone.—The presence of stone in the bladder is, for the most part, marked by an unequivocal train of symptoms; yet abundant examples are recorded of the existence of stone, and occasionally of large size, not discovered till after the death of the individual. But this is so much the exception to the rule, that little advantage can be derived from enlarging on this subject, because the interest connected with it is rather pathological than surgical,

* Lisfranc in Rapport sur la Taille et la Lithotritie. Paris, 1835.

† Mem. sur une Manière nouvelle de Pratiquer l'Opération de la Pierre. Paris, 1836.

no active treatment being required in such a case, even if the existence of the stone were ascertained, so long as it is unaccompanied with symptoms of inconvenience.

The symptoms of stone in the bladder, although well marked, are closely imitated by a factitious train, which are frequently met with, and are very deceptive in their indications. We are frequently consulted by the parents or friends of children, who complain of irritable bladder, accompanied by painful micturition, by emaciation, and generally impaired health. The bladder is painful on pressure, and intolerant of the presence of urine. On passing a sound into the bladder, the pain expressed is very great, in a degree, indeed, beyond that complained of when stone is present. Pressure on the organ in this condition usually occasions positive pain. The peculiar feature of such cases is characterized by a marked roughness of the bladder, which is hard, and uneven to the touch of the instrument, apparently elevated into ridges, and rugous.

I have described this condition of the bladder in children to my own pupils at the hospital for many years, often declaring that I have never known stone to be present under such circumstances; nor have I, and the moment I perceive it I withdraw the sound, as likely to aggravate the mischief. The only excuse for retaining it is the satisfaction it may afford to a natural and just curiosity. These factitious symptoms, pointing to the possible existence of stone in the bladder, predominate largely in children, but are occasionally found in the adult; but it is in the cases of children especially that these remarks are intended to apply, because I have known examples of this condition of the organ, accompanied and occasioned by stone in the adult. I have at this time two examples under my care which may be deemed exceptions, in one of which chronic inflammation followed the use of the lithotrite, the stone being reduced to a small fragment; and the second example occurs in the person of an old man, with a large stone, who is now under treatment. The true symptoms of stone are not, as in this case, confined to the bladder, but extend along the urethra.

It is a well known fact in surgery, that irritation at the neck of the bladder is referred to the glans penis, whereas disease either of the entire organ or of the prostate gland is referred directly to the region affected; affections of the bladder to the organ itself, and prostatic disease to the perineum. In the real presence of stone, we have irritation of the neck of the bladder, caused by the contrac-

tion of the organ on the stone, which increases as the urine escapes; and hence pain in the glans, of a character which is somewhat relieved by friction, and, consequently, the prepuce is drawn out and unnaturally elongated. This is a condition quite foreign to simple irritable bladder, whether accompanied or not by inflammation. So long as the coats of the bladder are separated from the stone by a quantity of urine, the bladder contracts without occasioning pain, but when a sufficient quantity has passed off to bring the two into contact, then pain immediately follows. This symptom is highly characteristic of stone. In stone, the expulsive efforts of the bladder are great, and hence frequent discharge of the contents of the rectum, and the sudden pressure of the stone on the neck of the bladder often interrupt the flow of urine from that cavity. This interruption may be repeated once or twice in each act of micturition. The presence of stone in the adult is often indicated by the addition of more or less of bleeding from the bladder, which is increased by exercise, especially on horseback, whereas, bleeding in children is not so common. Add to these symptoms of stone, the presence of a dull, bearing-down pain in the bladder and perineum, and the admixture with the urine, from which it gradually separates after being evacuated, of a greater or less quantity of muco-purulent fluid, and we have the symptoms of calculus in the human bladder. Adults will often describe the sensation of the stone rolling from one side to the other, as the position of the body changes.

On the Introduction and Use of the Sound.

Unlike the catheter, metallic bougie, or staff, each of which it nearly resembles in form, the sound, introduced into the bladder, is employed as the representative of the finger, as the organ of touch; and as I have had occasion in an earlier part of this work to claim for delicacy of manipulation, a clearer perception, and a more correct inference as to the nature of structure, both morbid and healthy, so in relation to the use of the sound, I would urge the necessity of delicacy, of gentleness, and of tact in its employment, not so much to the end of avoiding unnecessary suffering to our patient—an object of *some* consideration—but to that of enabling us to appreciate with more nicety what is going on at the further end of the instrument. There is also another motive for gentleness in our movement; viz., that if force be employed, and coarseness of mani-

pulation, in the case of a child, we have audible expression of suffering, and we lose the valuable aid of the sense of hearing, and are restricted to that of touch only. The patient should be placed in a position convenient to the surgeon and comfortable to himself. The sound should be rather small than large; contracted in the shaft, that it may play freely in the urethra, and short in the curve, that it may easily revolve in the bladder.

The instrument, well oiled, should be passed gently into the organ in the semi-recumbent posture of the patient, and the cavity is now to be systematically explored; first, in the centre from before backwards, by revolving the handle from side to side between the finger and thumb. The instrument is then to be withdrawn to the neck of the bladder, and its point directed, first towards one side, which should be fully examined, and then on the other; and, lastly, the handle being depressed, the point of the sound should be carried upwards, behind the arch of the pubes. If the evidence of the presence of stone be so conclusive as to render further inquiry desirable; and especially so, if the bladder be empty of urine, which will be indicated by the point of the sound coming in contact with its opposite surface on its first introduction, and by the obstruction to its movements in all directions, then the instrument should be withdrawn, and the bladder injected with warm water, at about ninety degrees of heat, of which about two or three ounces may be thrown into the bladder of a boy, and about five or six ounces into the bladder of an adult. This part of the operation should be effected very slowly. The sound, again oiled, is to be reintroduced, and carried over the entire surface, as before. Should this fail in detecting the stone, the patient should be carefully laid back in the horizontal position, and the pelvis raised above the level of the trunk, by being elevated on one or more pillows. If the bladder contain a stone, unless it be encysted, it will gravitate into the further part of the organ, and must be felt by carrying the sound backwards to meet and touch it. Should this proceeding, which need not occupy altogether more than five minutes, fail to detect a stone, our diagnosis is probably in fault, and the instrument should be finally withdrawn. Should, however, the presence of stone be detected, we must obtain all the knowledge of its size and nature, &c., that we can.

Its hardness and density will be indicated by its sonorousness; if very hard, it will ring like metal, and when struck, the sound will

be audible at the distance of many feet. This is the feature of the mulberry calculus; but the lithic acid stone is also distinct in the character and quantity of the sound it communicates. Whenever the presence of stone is audible to the bystanders, there can be no necessity for the adoption of a nearly obsolete practice, begotten in the days of the gold-headed cane and silk-stocking school, of handing over the staff to the charge of all the surgeons present in rotation, that their ingenuity may also be exercised in finding and striking it with the sound. If the stone be soft and inaudible; if its existence be equivocal, as in some forms of the mixed phosphates, then the surgeon has a right to claim an opinion from, and to share his responsibility with any number of persons present, and one or two of these should accept of this office.

The size of the stone, when discovered by the sound, can only be learnt by experience, and no rule can teach it; indeed the most experience can but approximate to the truth. Still we may distinguish altogether some very important features in the case, which may guide the future operation and determine us at once as to the form of operation to be performed. We can ascertain with some certainty the degree of density of the stone, and thus determine on the probable force required; we can form an approach in judgment to *size*, and we can ascertain position, by which we shall be enabled more readily to seize it with the lithotomy forceps, if that instrument be afterwards used. We can only explain this question of position by recollecting the relations and the structure of the bladder; that with respect to relation, it is placed behind the os pubis in front and in front of the rectum, and extends laterally beyond both; that in structure it is composed of muscular fibres, travelling over it in all directions, and which muscular fibres may grasp a stone when not very large, and hold it firmly in any part of the organ, whether the upper, the lower, or the lateral, from which locality, if undisturbed while yet small, it would probably eventually become encysted. Hence the advantage of exploring the organ by the addition of warm water, by which the coats are distended, and the stone allowed to gravitate. The introduction of the finger into the rectum of the adult of full size, especially if the perineum be more than usually deep, is of doubtful service; no finger of ordinary size can do more than simply reach the bladder beyond the prostate gland, nor even reach the organ if the gland be at all enlarged. Those who advise the introduction of the finger into the rectum, for the purpose of

drawing the stone forwards, and thrusting it into the blades of the forceps, have not had much practical intercourse with the operation for the removal of stone, or cannot be very familiar with the extent and relations of the prostate gland. If much time has been occupied in the examination, and much pain has been occasioned, the patient should be desired to lie down in bed for some hours, and a warm bath and an opium suppository be used, if necessary.

It is presumed that the surgeon has determined on his kind of operation, and I proceed to describe that of *lithotrity*.

ON THE OPERATION OF LITHOTRITY.

The attempt should rarely be made to break the stone, so long as the patient complains of much irritation in the bladder, or if such irritation be evidenced by the escape of muco-purulent fluid with the urine. If the urine be clear, and the bladder free from pain, the stone may be broken; yet there are exceptions to this rule. I broke a stone in the bladder of a gentleman, in apparent health. The operation was followed by chronic inflammation of the bladder, and a profuse discharge of muco-purulent secretion, which continued for months. In a consultation with Sir B. Brodie, he advised my repeating the operation. I broke the stone freely, and the bladder quickly regained its healthy condition. The operation is usually a very simple one, if well performed. The patient should lie on the end of a bed, or on a sofa, with his pelvis somewhat raised on a pillow or cushion. Through a full-sized catheter are then injected into the bladder about four to six ounces of water, at the temperature of about 85° or 90°. This should be done slowly. If there be the least difficulty in introducing the catheter in the horizontal position of the patient, he should be raised for the purpose. It is not a favorable position for that operation at any time, perhaps because we are unaccustomed to it. Before removing the catheter, it may be employed as a sound, and moved about gently in all directions. It is presumed that the presence of stone has been placed beyond all doubt. In such a case, *whether the catheter strike the stone or not, the operation should be proceeded with.* The lithotrite forceps, having been previously well studied, and their mechanism thoroughly understood, and readily manipulated by the operator, should be introduced warm and well oiled. This part of the operation

should be done with care and gentleness. On reaching the bladder, the instrument should be passed fully beyond the arch of the pubes, and into the centre of the cavity of the bladder. Unlike the lithotomy forceps, which are employed to find the stone and follow it to its position, the lithotrite takes its position in the bladder, and the art of the operator consists in bringing the stone into its grasp. This is an important distinction between the action of the two instruments. On dilating the blades of the forceps, or rather in withdrawing the near and movable blade, if pain be expressed, it is probably due to the instrument not being pushed far enough into the bladder; the consequence is, that the movable blade presses against the neck of the bladder, and the instrument expands with difficulty. Even though pain be not experienced in withdrawing the near blade, the act of dilating should implicate both of them. The remote blade of the instrument should be pushed downwards into the base of the organ, at the same moment that the near blade is drawn upwards.

When fully dilated, as proved by the scale at the handle, the lower blade is to be pressed firmly against the base of the bladder, and forced downwards against the rectum, giving the instrument at the same moment a jerk, which extends to the whole organ. By this pressure it is intended to depress its base, and elongate the bladder downwards into the summit of a cone, at the bottom of which the fixed blade of the lithotrite rests, and by the jerk the stone, if free, will almost necessarily fall upon it. If this shake or jerk of the hand create alarm in the mind of the patient, the same end may be obtained by giving a smart blow to the side of the pelvis with the open hand, or by taking the pelvis between the hands, and shaking it from one side to the opposite. One movement is sufficient. The stone falls on to the lower blade, and the instrument is screwed home. I am indebted to Sir Benjamin Brodie, who many years since gave me this valuable hint.

This may be repeated several times, perhaps six or eight, or even more, provided we are not deterred by increasing pain. The forceps, completely closed by the screw, are then to be withdrawn, and the contents of the blades examined. Under the best management, a portion of the mucous membrane will be occasionally involved, unless great care be taken to prevent it. Before withdrawing the instrument, and especially if pain be expressed, the blades should be opened to the extent of about one-eighth of an inch, until the end

of the instrument reaches the neck, or at least the middle of the cavity of the bladder; they may then be screwed home, and withdrawn.

It is a common practice to urge the patient to get rid of the fluid contents of the bladder on rising. This attempt is generally futile, and is better avoided. The bladder appears paralyzed by the violence done to it, and it more frequently happens that even continued straining fails to expel its contents. If the presence of the contents create much inconvenience, a catheter should be introduced, and the water drawn off. The patient is placed in bed, and a warm bath used, if requisite, to allay pain, and a suppository of opium may be introduced on the same conditions. From the period of the operation, the patient should be directed to pass his urine through a gauze, strained over the vessel. It often happens that a far less quantity of the fragments of the broken stone pass off in the first day than later. The operation may be repeated, so soon as the detritus of the broken stone is come away, and all irritation has subsided; and this may require a period of a week, ten days, or a fortnight, or more, when the operation may be repeated, as before.

As the stone becomes reduced in size, of course the difficulty in seizing the remaining fragments is increased, but it is all important that the residue of the stone be broken up, and additional care be bestowed on this important crisis of the case.

After each successive operation, a quantity of the broken fragments may be removed by the introduction of a very large catheter, with a portion of its end scooped out to leave a large opening.

Consequent on the operation for lithotrity, is the occurrence of an occasional evil of some magnitude, viz., the lodgment in the urethra of a fragment of stone. Retention may follow, with pain, swelling, and inflammation of the canal, often attended by great suffering.

This evil is of more probable occurrence in those cases of irritable bladder, in which the organ is very intolerant of urine, as evidenced by frequent micturition. Here the power of contraction of the bladder is too greatly reduced to enable it to expel the detritus of the stone, should a fragment of magnitude pass into the urethra. Under such circumstances, I once found, in the case of a gentleman in whom the operation had been performed but thirty-six hours, that the whole canal was distended, from the glans down to the perineum, from which I removed a very large quantity. This I

effected in the following manner. I removed all the fragments within about two inches of the orifice, by means of forceps, and then endeavored to pass a catheter into the bladder; but the canal was already occupied with stone, and I failed in this attempt. I then injected the urethra, and sufficiently filled the bladder with warm water to excite an irrepressible desire to evacuate it, and at each effort a quantity of fragments escaped. This I repeated till I had removed the whole mass. It is somewhat curious that the entire quantity broken was at this time in the urethra, and it was sufficiently great to fill half a large walnut-shell. Such cases of reduced muscular power of the bladder require extra care and watching,

Under ordinary circumstances, a long probe or director should be passed down the canal, very gently, to ascertain the position and the size of the fragment. These features, however, supposing it to have lodged within the penis, may be made out more readily by the finger, but not if in the perineum. A long and fine pair of forceps well oiled, should then be passed downwards, and the piece pushed backwards towards the bladder, about the eighth of an inch or more, turned round, and drawn out. This movement is necessary to disengage it from the fold of mucous membrane, by which it has become involved. If it be seized by the forceps the moment it is felt, the mucous membrane itself will be caught by the blades. If the fragment lodge in the perineum, and we fail in our attempts to disengage it, one of two courses is open to us, either to push it back into the bladder, or to cut down upon and remove it. Of these two courses, the first has the least objections, if it be practicable; and the endeavor should be made with a large metallic instrument, whether sound, bougie, or catheter. The latter, perhaps, is preferable, as it may be made the vehicle for conveying a good quantity of oil down the canal; which, by well lubricating the urethra, may facilitate the return of the stone. Should this attempt, well executed, fail, and retention, or even great suffering without retention, continue, not removed by the warm bath, and opium suppositories, we have no alternative but to cut down and remove it. The objection to this proceeding is, that we operate for that single fragment, and effect nothing for the remainder of the stone. The fragment is removed, and the difficulties of the case are rather complicated by the wound in the perineum.

For the purpose of removing a fragment, we make an incision straight down upon it, almost without reference to the anatomy or to

the structures divided. There can be no necessity for making an incision larger than sufficient to get it away. It should be seized, when exposed, by a pair of dressing forceps, and the fold of mucous membrane carefully detached around it. Unless the wound be large, the urine will always prefer its natural channel. An impression prevails of the greater advantage of making such an incision behind the scrotum, than through, or in front of it, grounded on the real or supposed difficulty of healing a wound made forwards into the urethra. I should be very unwilling to push a fragment that had lodged within one or two inches from the orifice of the canal, backwards into the perineum, although the objection may apply to division through the scrotum.

ON LITHOTOMY.

The first step towards the operation for the removal of a stone from the bladder is that of ascertaining, beyond all doubt, its presence in the bladder. The indispensability of this law in operative surgery is acknowledged by all good surgeons. I myself witnessed two operations unproductive of stone, in the early period of my professional career. This was formerly not so very unusual an occurrence; and I remember to have heard it asserted of a surgeon, who was so unfortunate as to have his cutting propensities called into frequent requisition, that he never undertook this operation without being provided with a well-selected stone in his pocket!

The table selected should be firm, narrow, and of a suitable height. This height is rather relative than positive, referring to that of the chair or stool on which the surgeon takes his seat. It was formerly the practice to operate on one knee, but it is an objectional position on many accounts. The patient should sit on the end of this table, leaning back in a semi-recumbent position during the introduction of the staff.

If the contact of the staff and the stone be distinctly audible to two or three persons, while directed by the hand of the operator, it is sufficient.

The old grievance, that of operating upon deficient evidence of stone, has, as might be expected, led into a fault of the opposite kind; and now, unduly influenced by fear of error, operating surgeons shrink from a necessary responsibility, and exhibit a hesi-

tating faith in the evidence of their own senses. In the cases of lithotomy (if the term in such examples be etymologically correct), in which one important feature of the operation, viz., the presence of a stone, was wanting, it should be recollected that a stone had not on any previous occasion been felt, for the bladder had never contained one; whereas, in the examples I allude to, a stone *has* been felt and heard, and its presence acknowledged by many. It is a very good and salutary rule in lithotomy that the presence of stone in the bladder be ascertained at the time of the operation. But, on the other hand, it is well known to all persons familiar with the structure of the bladder, under circumstances of such disease as may have interrupted the concentric form of its natural contraction, by the interposition especially of a foreign body, that we may find nooks and corners in any part, which accident alone may occasionally detect. If the evidence of stone, ascertained within the period of a day or two, be conclusive, and if at the hour of operating any one competent authority declares that he has felt the stone at the instant, it is sufficient to justify its performance. If the operator have reason to place confidence in the competency of that person, whose assertion is unequivocally and confidently made, although ten or even a hundred persons fail in their attempt to acquire the same evidence, such negative evidence ought not to counterbalance the weight of his positive testimony, backed by the already-ascertained fact of the presence of stone within a day or two, and by the symptoms of stone which have continued up to the moment. Under similar circumstances to these I have known many a patient returned to bed, with the operation unperformed. This practice is not dictated or governed by the laws of evidence, and betrays a want of moral courage on the part of the operator.

The office of the staff is that of conducting the knife along its groove into the bladder. This instrument has assumed forms quite Protean in variety, from the largest curve up to nearly a straight line. The latter form was adopted by the late Mr. Aston Key, who operated with great success, but I do not think it will be found a safe instrument, for reasons I shall presently give, or that its employment will be found to facilitate the operation. The staff in general use is objectionable, because its point, when held vertically, barely reaches the bladder, and requires the handle to be depressed during the operation; whereas, from the moment of the first incision to the final cut into the bladder, the staff should be held firmly and

immovably, whether by the assistant or by the operator himself. In order to perform the operation of lithotomy with ease and safety to the patient, the point of the staff should be at least an inch or more within the bladder from the beginning. I am quite aware that it is the practice of some surgeons to depress the handle of the staff, while cutting into the bladder, but I cannot consider the practice otherwise than a dangerous one, nor does it appear to me to answer any useful purpose, so long as we have the power of placing the instrument, at the commencement, in the track along which we have to divide throughout the whole of the incisions. Again, in order to meet the greatest of the difficulties in the operation of lithotomy, that of cutting into the groove of the staff, it is most desirable that the staff be brought *close to the surface of the perineum*, and distinctly felt by the finger pressing it; and in order to facilitate the

Fig. 74.

easy passage of the knife along its groove into the bladder, the horizontal or last position of the instrument should be as straight as pos-

sible. The straight staff of Mr. Key, however successful in his hands, has this defect, that it forms no guide, and, as it were, gives no support to the first incision. It is, however, very efficient as an agent of directing the second incision into the bladder, when its groove is once opened. The projecting convexity of the staff should be distinctly felt on the perineum before making the first incision. This is impossible, either in the case of the common staff, or in that adopted by Mr. Key. The curve I recommend has another advantage, viz., that it elongates, or renders tense the perineum, in which state a cleaner cut is made through it by the knife. If made convex in the perineum and straight beyond the curve to the point, these two important indications will be answered, viz., facility of exposure of the groove, and ease in the transmission of the knife into the bladder.

In reference to the groove, it should be as large and as deep as possible, consistent with the strength of the instrument, and especially so in that portion which projects into the perineum, and at which point it is first exposed. The groove may be made in front or on the side, or intermediately between the two. I have usually, with Mr. Liston, preferred the latter. The lateral groove does not appear to me to answer any useful purpose, and is certainly not so readily exposed, and the front groove, if it be necessary to keep the staff in a fixed position, does not permit of its entire depth being employed by the knife in cutting along it into the bladder. The groove should terminate at about the distance of a quarter of an inch from the extremity. The handle of the instrument should be large and strong, that it may be firmly grasped by the assistant, who is responsible for its entire immobility, until desired to remove it.

The mode of holding the staff by the assistant is all important. The best and most conveniently formed staff may fail in its office, if negligently held, and abundant injury result to the patient. It should be held by the right hand of the assistant, or rather by the stronger extremity, it is unimportant whether by the right or left. A rule formerly prevailed, that the staff should be held by the left hand. I could never obtain an explanation of the necessity, and I broke the rule in my first operation. The staff should be well supported, and more than supported, it should be *raised and drawn towards the arch of the pubes*, and there held until the bladder is opened. If, in a protracted operation, the arm of the assistant becomes fatigued, he is apt to let the staff gradually sink on to the

rectum for support and steadiness, for the position is an irksome one, and fatiguing to the muscles of the arm under untoward circumstances, by which the operation is prolonged. If, in the performance of the operation of lithotomy, the rectum is wounded, it is generally the fault of the assistant, not of the principal. It may be entirely avoided by the horizontal part of the staff being made straight, and by the instrument being well raised against the arch of the pubes by the assistant.

The cutting instruments employed have been greatly simplified of late years, and so far improved. The gorget has become almost obsolete, not so much in obedience to its intrinsic defects, which may be corrected without much art, but because all instruments not radically good have a term of existence only, at the expiration of which they die a natural death. It is an instrument too well known to require description.

Its objections may be found in the necessary change of instrument; secondly, in the great extent of its cutting edge; and, thirdly, in the force required to carry it through the prostate gland into the bladder, due to the imperfect angle at which its cutting edge meets the surface to be divided by it. The evil of the second objection can only be remedied by aggravating that which is incidental to the third.

Long, straight, probe-pointed knives were then substituted, and among others, was one long employed by surgeons, and recommended by Mr. Thomas Blizard. The objections to this modification are, first, the necessary change of instrument, and, second, the uncertain extent to which the prostate may be divided, and regulated by this knife with difficulty.

The entire operation should be completed with one knife, as first performed by Mr. Aston Key. Any strong scalpel will answer this purpose, but it is well to have the back of the knife curved a little downwards at the end, in order to prevent the point of the instrument hitching in the groove while passing along it, and the point should be obtuse, being formed by the back and cutting edges, each curving to meet the other. There is no advantage in having the cutting edge of its usual length. In the ordinary scalpel, not more than one-third of the length of the blade is often used, and one inch and a quarter will suffice to effect all the cutting required of the lithotomy knife. When of considerable length, it is a clumsy instrument, and ill adapted to the hand in making the first incision. The

handle should be long enough to admit of the point being carried into the bladder, while held firmly in the hand.

The lithotomy forceps should be adapted to the size of the organs operated on. I have myself a great objection to the ponderous instrument in common use, for the same reason that I have an equal objection to the force occasionally employed in dragging a stone out of the bladder through an opening inadequate to its transmission. It is difficult to exhibit delicacy of tact with a large and clumsy instrument, the very character of which unconsciously conveys its influence to the hand that wields it. Forceps should be made lighter and thinner than those now in use, and should occupy as little of the wound, in addition to the breadth of the stone, as possible. They are more tenacious if the blades be lined with kid leather. The handles should resemble the entire loops of scissors. When one end is open, formed by a simple curve in the metal, the finger not infrequently escapes from the loop, and the instrument slips from the hand. Additional security in the power of retention of the stone is given by the application of a ring of India rubber, connecting the two handles. Two or three varieties in the size of the forceps may be required in each operation.

An injecting syringe, and a short gum catheter to fit on to it, are requisite in every operation for lithotomy, be it required for use or not, and is employed in all cases in which the stone is broken, to wash out the bladder. To effect this object an elastic bottle is a very bad substitute. The expulsive force is difficult of regulation, from the necessary effort required to effect its steady and continuous pressure. The current issuing from it is irregular, and often interrupted, and its direction is always regulated with difficulty. I do not recollect to have seen an instrument called a scoop, which is invariably found in lithotomy cases, called into useful requisition.

One word with respect to the means employed for fixing the patient in the required position. The close apposition of the palms of the hands to the feet is a matter rather of convenience than essential for the well performance of the operation. Generally speaking, there is no objection to it, irksome and disagreeable as it may be to the patient. But in old age I protest against it, as barbarous and inhuman. I once heard an old man say, "it was more painful than the operation," and I do not see why straps of leather should not be fixed around the wrists and the feet, which, being brought together, might be adjusted to the flexible capabilities of

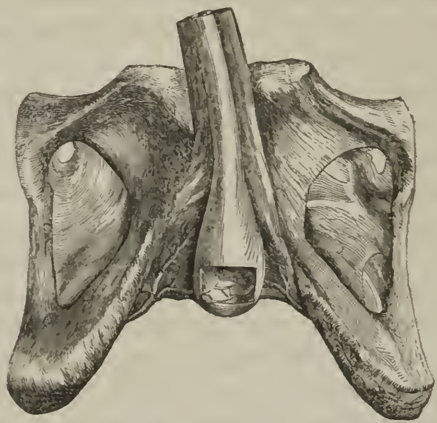
the patient, whether in mid-life or in old age. The garters are more frequently applied inefficiently than well. In a protracted operation, it is not unusual for the extremities on one, or even both sides, to escape. They should be rolled smoothly around both wrist and ankle, and deliberately applied by each person, without reference to the proceeding of the opposite party. The failure in the application is occasionally due to a perhaps unconscious sentiment of rivalry between the two assistants!

Before I proceed to describe the operation for lithotomy, I think it necessary to make a few remarks on the subject of the structures divided by the knife.

No two descriptions can more entirely differ from each other than that of the anatomical, and that of the operating theatre, in reference to the operation for stone. By the non-practical anatomist we are told to make a superficial incision of certain dimensions through the perineum, to avoid the bulb of the spongy body, to beware of the artery of the bulb, to exercise due caution that we do not divide the pudendal artery, to open the urethra behind the bulb, which is required to be pushed on one side by the finger, to avoid the perineal artery, to cut the triangular ligament, urethra, prostate gland, &c. &c. But what surgeon permits such rules to occupy his mind from the moment he takes the knife in his hand? The operation for lithotomy is really under few restrictions from anatomy. The only important rule consists in not extending our incisions too far from the mesial line. We are directed not to divide the bulb. Why not divide the bulb? It is an unimportant structure, and may be cut with impunity. The bulb was always necessarily divided in the Marian operation of dilatation. Yet we hear nothing of hemorrhage. We are told to beware of the artery of the bulb. Whence this caution? The artery of the bulb is scarcely larger than a digital artery, which we rarely tie when divided. In order to avoid these two objects, we are directed to introduce the finger into the wound, and press the bulb and rectum out of the line of division. Who ever saw the finger introduced into the wound for this purpose, or, indeed, who ever had a passing thought of either the bulb or its artery, from the moment of his first incision? My experience of the structures divided in lithotomy is obtained from many dissections of these parts, after operations on both the living and the dead, and the result is this, viz., that the bulb is always more or less divided and the artery of the bulb frequently, and the

perineal artery rarely escapes, when the external incision is more than usually long. I would go further, and say, that I do not see how it is more than possible to avoid the bulb. If the reader will recollect how entirely the membranous part of the urethra is con-

Fig. 75.*



cealed behind it, and how necessary, for the avoidance of the bulb, would be either a very circuitous route taken to the prostate, or else an external incision made considerably further from the mesial line than the directions require, I think he will agree with me that the only mode in which the given instructions for the direction of the line of operation can be obeyed is by cutting straight backwards through the side of the bulb.

The practical surgeon of experience has another advantage over the unpractical anatomist, in his better knowledge of the kind and extent of the incision of the prostate gland, and of all the rules connected with the subject of lithotomy, if there be one more important than another, it is that which guides us in our division of this organ. Upon the extent of this division the question of danger may be said to rest, the safety of the operation being almost in a ratio with the limited extent of the incision into it. Such were the grounds of success attending the Marian operation of dilatation of the prostatic portion of the canal, as well as that of the late Mr. Martineau of Norwich. This opinion was adopted by Sir Astley Cooper, and is adopted and advocated by Sir Benjamin Brodie;

* The above sketch is taken from a direct preparation in the Museum of St. Bartholomew's Hospital.

by Mr. Green, one of the most successful lithotomists in England, and by many other eminent men. By all these authorities we are told that a large division of the prostate gland enhances the danger of the operation, by increasing the liability to infiltration of urine into the pelvis. A sufficiently large incision is made into the prostate gland, if it admit the passage of the forefinger through it into the bladder. But as this opening is insufficient for the passage of the stone, it must be dilated by the finger, and by the forceps. The gland is said to be extensible in its structure, and the opening through it certainly admits of considerable dilatation. Hence the evil of cutting knives and gorgets, which are uncertain in the extent of their incision. It is then a golden rule in lithotomy, to extend the incision very partially through the prostate gland, and to complete the opening by dilatation.

As a preliminary measure, it is essentially necessary that the rectum be free from contents at the time of operating. This may be effected by a small dose of castor oil, given early on the morning of the operation; and by enemata, if necessary, administered immediately before it.

Operation.—Before the patient is brought into the operating-room, I conclude that some idea of the size and composition of the stone has been formed, by which we may in some measure regulate the extent of the first incision; that the patient's stomach be free from solid food; that the rectum has been cleared of its contents without purgation; and that, if necessary, the perineum has been shaved. An efficient and suitable table and a good light obtained, the immediate preliminaries to the operation may be commenced, by the introduction of a catheter, through which about four ounces of water should be injected with a syringe, if it appear on inquiry that the bladder be empty. If two or three hours have elapsed since the patient has passed water, this proceeding may be dispensed with. The staff is introduced in the semi-recumbent position, and is employed as a sound to detect the stone. When felt, and not until, the hands and feet of the patient are to be bound together by the garters, on the conditions previously given. The operator takes his seat in front; adjusts the staff, the handle of which he inclines somewhat over to the patient's right groin, thereby directing the groove towards the side on which he operates. The knees are to be separated by two persons, one of whom should support the scrotum, if pendulous. Before commencing his first incision, the surgeon

presses his finger on to the perineum, to render himself quite clear as to the exact degree of projection of the staff, and its position with respect to the raphæ, &c.

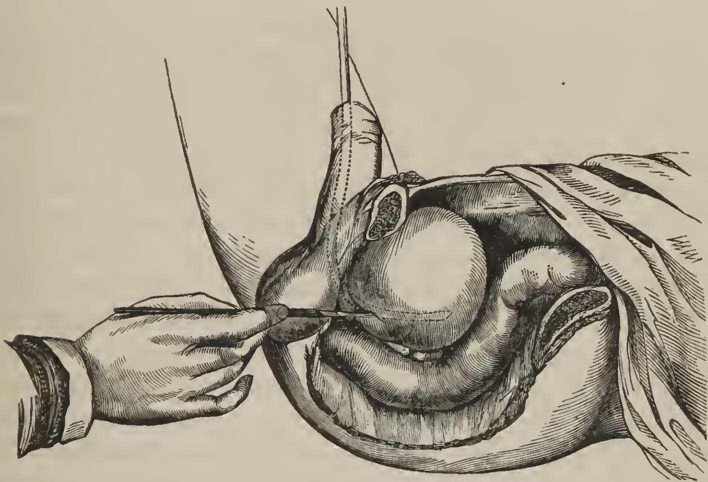
The first incision should be commenced one inch and a quarter above the orifice of the anus, in the full-grown adult; three-quarters of an inch in a child, either in the mesial line, or about one-eighth of an inch to its left side. At this point the knife is introduced, and pushed straight backwards at once into the groove of the staff. Having reached the groove, the incision is then carried obliquely downwards, slowly and deliberately, between the tuber ischii and anus, but nearer to the former, to the extent of about two inches in the adult, but proportioned to the probable size of the stone, diminishing in depth as we recede from the mesial line. The lower part of this incision exposes the deep fat of the ischio-rectal fossa. The forefinger of the left hand is immediately introduced into the wound, at its upper angle, to feel for the groove.

If the urethra be opened, the finger-nail should guide the knife at once into it. If the opening be not completed, the nail should be pressed firmly on the groove, and an incision made into it upon the nail. This incision is effected more readily by turning the edge of the knife upwards, and cutting into the groove from below. When the groove is distinctly bared to the extent of some three or four lines in length, the point of the knife is to be placed in it, the contact of the two metallic surfaces is too palpable to render it necessary for the operator to raise his head, with a view to compare sensations with the assistant holding the staff. The knife should then by the gradual movements of the fingers, be advanced from the hand, at least three inches in length ; care being taken that, during this change of the relations of the two, the point does not slip from the groove. If everything has hitherto gone on smoothly, and the surgeon has entire confidence in his assistant, he may pass the knife onwards at once into the bladder. I, with some others, find it preferable at this stage to take the handle of the staff in the left hand, while making this important division. We may thus avail ourselves of the natural harmony of action, always existing between the two hands of the same person. In passing the knife onwards along the groove, it is to be directed forwards, with the handle slightly depressed, and may be held either in the first position, viz., that of a pencil, or may be grasped by the fingers while resting on the palm. The point should be urged on till it reach the end of

the groove of the staff in the bladder. Throughout this incision the back of the blade should exercise some pressure against the groove, which will render the escape of the knife from it more difficult. The forefinger, in constant requisition, quickly follows the knife, through the opening made into the bladder, which is succeeded by a gush of urine. If the opening in the bladder be sufficient to admit the forefinger with ease, the forceps may be introduced.

If the opening be small, and yet not too small to require enlargement by the knife, the staff should remain, and the finger be em-

Fig. 76.



ployed for a few seconds in dilating the opening through the prostate. The forceps may then be introduced, warmed and oiled, along the staff, but guided by the left index finger. When the forceps have entered the bladder, the staff may be withdrawn by the assistant. The forceps, on entering the bladder, are not to be opened, but should be employed as a sound, and moved gently about to find the stone, and having come into contact with it, then the blades may be expanded upon it, and the stone seized. In the endeavor to extract it, some force and some tact are required. It is very natural for a young operator, in the triumph of a moment, which shall complete a hitherto well-executed operation, and who is conscious that his seconds, perhaps his minutes are numbered, by some friendly bystander, indulging in the vicious practice of counting the time by his stop-watch, or himself betraying the yet more

culpable folly of admitting its influence on his actions, to draw his operation to a close, by the injudicious employment of unwarrantable force.

This force, whatever its degree, should be exerted in such a direction as to avoid the chief obstacle, namely, the bone. For this purpose the line of traction should be made obliquely downwards upon the rectum, inclining the stone towards the more dilated opening, formed by the expanded rami of the ischia. By drawing straight outwards, the progress of the stone is arrested by the contracted opening formed by the bones converging towards the arch of the pubes.

This should be avoided. If a considerable and persistent effort be made without success, the forceps should be turned to find, if possible, a more suitable axis for its passage. The effort should be slowly and steadily made, in the assurance that the wedge-shaped surface presented by the forceps will eventually succeed. Not that I would counsel the continued application of force; if the opening be too small, if some minutes have elapsed, it is better to dilate the wound to the extent of some two or three lines. If this dilatation be rendered necessary by the *smallness of the opening*, the incision should be made in the direction of the former line of division; if in consequence of *the unusual size of the stone*, far better to divide the opposite lobe of the prostate, through which a large addition may be made to the size of the opening, without the risk of evil resulting from the division of the gland close upon its lateral surface.

When the stone is removed, it should be examined, with a view to determine whether it be entire or otherwise. If fragments be left behind, either in the bladder or in the wound, too minute to be caught in the forceps, the bladder should be washed out by the syringe. The largest sized elastic bougie being introduced fairly within the cavity of the organ, an eight ounce syringe may be emptied once or twice, with force, into it. During this operation it will facilitate the escape of the loose fragments if the trunk of the person be raised as upright as possible. The garters should be removed at the earliest moment practicable.

The quantity of blood lost in an operation for lithotomy varies a good deal in different subjects. It may be comparatively large or small. The chief flow of blood follows the first stage of the operation, and is produced from the venous system of the region. The only arteries worthy of mention which are liable to be divided, are the

artery of the bulb and the perineal, both of which conjointly could not produce the quantity lost. This bleeding is not in the least degree alarming, and may be permitted to flow for any moderate length of time. The arterial bleeding is from the artery of the bulb, and in rare cases, is very protracted, continuing for an hour or more to trickle from the wound. No attempt should be made by mechanical means to plug or otherwise stop it.

The trunk of the pudendal artery is in no danger in the operation of lithotomy under the circumstances of its ordinary course. We may almost affirm that it is impossible to divide it. It could only be divided on the dead subject, by scooping the knife round with a long sweep, within the left ramus of the ischium, where it lies three-quarters of an inch from the margin of the bone. In rare cases, the artery pursues an irregular course, and without leaving the pelvis at the lesser ischiatic notch, it descends in a straight line along the side of the prostate, and, under such circumstance, is almost certain of division in the lateral operation of lithotomy, as has been evidenced in one unfortunate case, the fatal issue of which can have no influence in modifying the operation, so rare is the combination of irregular distribution of this vessel with lithotomy. In my own intercourse with the dissecting room, of thirty years, I have not witnessed more than half a dozen examples of it.

Looking to the large size of the veins that occasionally present themselves in the neighborhood of the prostate gland, as observed on dissection, some considerable bleeding might be expected in this operation, from their partial division. I cannot say that I am familiar with the fact of their liability, however, to become varicose, to which condition their disposition to bleed has been occasionally referred. Should the bleeding continue injuriously, the patient may be brought to an open window, or remaining in bed, the pelvis, divested of clothing, should be raised on a pillow, and cold cloth occasionally applied over the perineum. The only treatment adopted for the wound is that of applying a handkerchief round the thighs, to prevent their being separated.

On being returned to bed, the patient is usually placed on his back. Better, perhaps, to place him on the left side, to facilitate the gravitation of the urine, passing through the wound. At this time, unless the operation has been much prolonged, and the bleeding, from accidental circumstances, has been unusually great, he is not much exhausted, and if the incision through the prostate has

been of moderate length, the prognosis will be highly favorable. The chief treatment, and that is almost negative, consists in preventing the wound becoming clogged with coagula. If local pain, or any sense of distension follow, the wound should be examined, and either a large sized elastic catheter or the finger, well greased, should be carefully passed into the bladder.

With respect to inflammation, whether of the bladder itself or of the peritoneum, I would venture to caution the young practitioner against too great apprehension of its probable occurrence, and also against the error of mistaking a sense of general uneasiness, or even of tenderness of the abdomen, consequent on many, perhaps on most, operations of lithotomy, for the signs of true inflammation; and in the occurrence of positive inflammation, to rely rather on the influence of mercury, conjointly with moderate depletion, than on the repeated application of leeches to the abdomen, and general venesection.

The only important modification of the operation which I shall allude to, is that in which it is complicated with enlarged prostate gland. The fact of this enlargement must have become known prior to the operation. It will be suspected on the introduction of the requisite instruments into the bladder, and confirmed by examination by the rectum; moreover, the patient will be advanced in years. The existence of the ordinary enlargement of the gland, even though great, does not admit of any substitute for the lateral operation, however positively it may increase the difficulty of its execution, unless, indeed, the organ is so unusually large in all directions as to preclude the introduction of the staff through the urethra, when we have no alternative but the high operation, or that performed above the pubes.

In cases of ordinary enlargement, the staff should be curved upwards, between the perineum and bladder, or for the last two or three inches. The knife employed should be somewhat larger than usual, and the division of the gland more extensively made; still relying, however, rather on the finger, if sufficiently long, to reach the cavity of the bladder, and on the dilating influence of the forceps, to form an opening of sufficient size to admit the passage of the stone. But the staff should not be withdrawn from the bladder until this opening is effectually made. The operation requires time for its completion. It should be executed with unusual deliberation, under the influence of chloroform. The result of my observation

of such cases, whether under my own hand, or that of others, has been favorable to recovery. I have never known a case prove fatal from this cause, and I have witnessed more than one example, in which, after recovery, the symptoms of enlarged prostate have entirely subsided.

With respect to the high operation for lithotomy, I have neither performed nor witnessed it, and I must refer the reader to other more competent authorities for information.

CHAPTER XIX.

LATERAL CURVATURE.

LATERAL CURVATURE OF THE SPINE.—NATURE OF THE DEFORMITY.—CAUSE, REMOTE AND IMMEDIATE.—PRINCIPLES OF TREATMENT.—POPULAR ERRORS.—AGENTS OF TREATMENT.—OPERATION OF TENOTOMY.

Among other kinds of deformity, for the treatment of which the agency of operative surgery is occasionally employed, is that arising from lateral curvature of the spine. It is very true that these resources are not often very available to good, and that the operation for dividing the tendon of the erector spinæ is comparatively rarely resorted to, and has been still less commonly adopted in this country; but when we consider the frequency of this distressing affection, and the general want of success attendant on its treatment, consequent on its somewhat exclusive, and not very scientific character, although lateral curvature may hardly enter into the catalogue of those diseases which engage the particular attention of the operating surgeon, yet I cannot persuade myself to pass the subject by without the endeavor to enforce the importance of certain principles, the observance of which appear to me indispensable to the limited success that must ever attend them.

It cannot be denied that a disease, or rather a distortion of this kind, which involves the morbid action of the immense number and variety of the muscles of the trunk, greater than any other known disease, demands a more than general amount of anatomical knowledge for its treatment—a knowledge of the attachments and action of the muscles involved in the abnormal condition of the body; nor can it be denied that the class of practitioners, by whom the treatment of lateral curvature is greatly monopolized, do not in general possess that intimate knowledge of their actions, or of the means of developing their growth and their relative importance in the economy, which is so requisite for success. The treatment gene-

rally adopted in this country, as well as on the Continent, is, in my opinion, so perfectly erroneous in principle, that it is not surprising how little is gained by its adoption, and how universal is the feeling of dissatisfaction expressed by the parents and relatives of the affected persons.

The cause of lateral curvature, if considered in its most remote relation to the effect, is the presence of some temporary imperfection of one, or of inequality of power between the two lower extremities, as the pillars of the trunk. So long as the weight of the body is transmitted to the ground by two pillars of equal strength, so long will the vertebral column occupy the central space between them; but reduce the value of either as a pillar of support, and the weight remaining unchanged, the opposite limb performs the extra duty. But as the spine is rendered flexible for the purpose of facilitating the transmission of the weight of the body to the perpendicular line over each leg in progression, so the continued disposition to form a perpendicular over one extremity, rather than occupy the centre between the two, is effected at the expense of the opposite limb; and the spine, accustomed to assume this direction, gradually loses its symmetry, and becomes permanently drawn from the centre to that point over which its weight is most readily, and with the least effort, transmitted to the ground. The primary cause may present itself in the most apparently insignificant form. Any source of local pain, such as chilblain, a tight shoe, or a sprained ankle, is sufficient to effect all the injury that may ultimately follow in its train.

We are, however, concerned with the effects, which unhappily advance by such insidious steps as to render distortion positive before it has created observation. The eye of the servant or attendant has become familiarized to the growing evil, and months may elapse before the suspicion of wrong is whispered in the family. The effects of curvature are manifested, not on the spine, but on the ribs, which being fixed at each extremity to the vertebral column and to the sternum, are pushed outwards at their angles behind. The enlargement thus formed is the result of the second curve, not of the first. The first deviation from the vertical line of the spine occurs in the centre of the body, where nature has given the greatest degree of mobility to the column, viz., in the lumbar vertebræ. This first deviation requires a second, in order to bring back the head to the centre. It

is this second deviation in the dorsal region of the column that causes the general distortion.

The projection backwards, though caused immediately by the distorted form of the ribs, is further increased by the necessary relation of the scapula and shoulder placed upon them. On the opposite side the scapula lies with its anterior surface applied on the flat surface of the ribs. Whereas, on the affected side it lies on the projection formed by the eminence of the distorted ribs. It is thrown upwards, and the consequent elevation of that shoulder is inevitable. As the disease advances, the projection behind becomes greater, and in the same degree the ribs become flatter at the side of the chest, and this cavity gradually loses in front what it has gained from the projection behind. By the concavity of the curve directed towards the opposite side, the ribs of that side approach unnaturally towards each other, the intercostal muscles become absorbed, and the ribs eventually overlap. From some cause or other, the dorsal curve is, in young women, almost invariably to the right side, with its concavity to the left. In boys it is frequently reversed. The capacity of the chest is materially altered. The act of respiration is performed very disproportionately on the two sides. While that of the projecting ribs permits the full expansion of the lung, particularly in the antero-posterior axis of the chest, although that lung is flattened at the side, the opposite and generally the left side of the thorax, is materially abridged of its natural dimensions. The lung is reduced in size, and heart is forced to the mesial line behind the sternum, or sometimes to the right side of that bone. In the aggregate, the capacity of the lungs is reduced in volume, and the general health betokens difficult and impaired respiration. Such patients will always adopt the side position in bed, lying on the weaker or contracted side of the body. If the two hands be applied on the side of the chest, in the act of inspiration of the patient, the difference of degree to which each lung enters into that function will be obvious. The influence of this condition on the muscular system of the body is equally worthy of remark. All the muscles of the upper extremity, on the side of the projection, are fully developed, while those on the opposite are in the same degree reduced in volume and in power. If the two arms be extended to a right angle, it will be observed that the one is held more firmly and longer than the other. If a dumb-bell be placed in each hand, the difference becomes still more apparent. The lower extremities give equal

evidence of the inequality of their power. The large muscles of the spine, the especial office of which is to maintain its upright position, and which, consisting of the sacro-lumbales and longissimi dorsi, are called the levatores spinæ, from their action, undergo also considerable change from their natural form and bulk. The lowest part of these muscles, which corresponds with the lumbar vertebræ, are enlarged by excessive action on the left, or convex side of the lumbar curve, and are in the same degree atrophied on the opposite. The same muscles in the dorsal region have their conditions reversed, that of the right side being enlarged, that on the left reduced and almost absorbed. The trapezius muscle, where it occupies the back of the neck, is swollen into a thick cord-like mass, and is equally small on the corresponding one. The same remark applies to the serratus magnus and latissimus dorsi muscles. Such are the effects produced by the first deviation from the natural form of the spine. Young persons in this condition are incapacitated for occupation, and for most of the enjoyments of life.

The first question that should be asked, is, Does such a case admit of cure? The answer is, *Certainly not;* and the first duty of the surgeon is to impress this fact on the minds of the responsible persons concerned, or at least to admonish them against the indulgence in a hope that cannot be fulfilled. All the benefit that art can furnish is improvement, and the degree of improvement depends, first, on the age of the person, whether in childhood, or girlhood, or yet of more advanced age; secondly, the firmness or flexibility of the frame; and, thirdly, on the moral aid afforded to the surgeon by the resolution and capacity for endurance exhibited by the patient. As a general rule, the latter quality is developed in proportion to the advanced age of the subject. When a girl reaches seventeen or eighteen years of age, and finds herself insulated from the society, and deprived the amusements and occupations, of her natural associates, the deprivation begets a vigor of resolution that will sustain any effort or suffering without complaint. For myself, I make it a rule of conduct to decline the charge of a case, without I possess the full confidence of my patient, and unless I observe a manifest disposition to enter on the treatment with earnestness and resolution.

With respect to age, the less advanced the better. Lateral curvature rarely exhibits itself under thirteen or fourteen years of age, and it is very seldom that parents have recourse to surgical aid for one or two years afterwards; or, indeed, to state the case more truth-

fully, it is rarely that any approach to efficient treatment is resorted to till the expiration of some two, three, or four years, when the advancing distortion attracts the notice of casual observers, and not till then are all the resources of surgical skill called into requisition. In the outset of the case, the mother exhibits the girl (for this malady prevails in females to the extent of nine out of ten cases) to the surgeon attending her family, who recommends friction and exercise. Occasionally the treatment involves rest in the horizontal position, and the application of a bandage, or some form of spinal support, with which the family remain contented. But some of the worst cases I have attended have been treated by friction alone, and occasional rest. If a girl be under fifteen or sixteen years of age, great benefit may be obtained by positive treatment, but the amount will lessen with the advance of every year beyond. With respect to the time required for such partial recovery as the case admits of, it *must be calculated by years*, not by months. It is impossible to effect any considerable improvement in the figure, much distorted by curvature, within a period of two years, or to confirm the benefit then obtained, without the loss of a third. I do not hesitate to say, that the promise of an earlier result could never be realized, whatever treatment be adopted, because growth is indispensable to recovery. The restoration of the projecting ribs and the spinal curve cannot be effected but by the agency of time, and no art can accelerate the speed of natural growth.

The agents usually resorted to in lateral curvature are, as I have mentioned, friction, bandages, and rest. The indications to be obtained, are those of straightening a curved spine, forcing back the projecting ribs, and restoring equality of action to the muscular system of the two halves of the body, by developing the power of those muscles whose action has been long held in abeyance. Among the latter, the intercostals stand prominent, both in importance in the healthy economy, and in difficulty of access.

Against these requisitions, let me point to the agency of friction, bandages, and rest! A supposed advance in the treatment, which carries patients onward in the path of delusion, consists in the resort to gymnastic exercises, in climbing, hanging the weight of the body by the arms, using dumb-bells, &c. What is the efficacy of gymnastic effort in reference to curvature of the spine and distortion of the ribs, the real gravamen of the disease? Can exercise elongate the spine? can suspension of the weight of the body by the latissimus

dorsi and pectoralis major press into place the firm projecting ribs, or expand the chest in its transverse diameter? If not, little has been accomplished. Exercise may, by developing the muscular system, mask, but it cannot even tend to cure the deformity, and the mask holds good only so long as the exercise is continued, and no longer. There can be no objection to, but on the contrary, the greatest benefit arising from exercise; but it is ill-timed; it should *follow* not *precede* other treatment, and to rely on exercise alone, is to abandon the case to permanent deformity.

With a view to select the most efficient treatment, we must keep in view the requisite indications. We are required to straighten the spine, to regain the natural form of the ribs; that is to say, we have to reduce the prominent feature of the deformity, viz., the projecting ribs on the one side, and to enlarge the capacity of the chest on the other, by effecting an equal change in their abnormal curve, and, finally, to strengthen the muscular system.

The first consideration in the treatment consists in removing the cause of the entire evil, viz., the superincumbent weight. The patient must be confined to the horizontal position. The evil is not so great as it appears. The horizontal position is quite compatible with health, with education, and with the enjoyment of life. A narrow bedstead should be selected for the purpose, of about three feet in breadth, and moving on large wooden castors, by means of which it may be wheeled about in any direction, altering its relation to the room, both by day and night. The patient should lie on a well made wool matress. There is no objection to one of Earle's beds, which might be so constructed as to move on wheels in a garden, or at least out of doors. With respect to health, I have had abundant opportunity of observing, that if not improved, at least it is not impaired. I have never seen an example of injury to the health from the required confinement. Education, so far as relates to the acquisition of knowledge, may be advanced, and is advanced more positively, than by others who pursue the more general routine of occupation. As regards accomplishments, neither music, except in theory, drawing, nor dancing is admissible. Any form of needle-work is unobjectionable.

How is the spine to be now elongated? It will not grow straight from the impress of four years' curvature. It must, therefore, be drawn out, by the application of weights, which will operate by the reverse action to that of pressure downwards, under the influence

of which the disease has grown to maturity. Extension should be made from the two extremities of the spinal column; that above, by a belt applied around the chin and occiput, attached to a cord passing over a pulley, let into the head-board of the bed, and supporting a weight of from ten to twenty pounds. That below is attached by a broad belt around the pelvis, and including the crista of each ilium. To the sides of this belt are two straps, that unite below, and to them may be attached a weight of from twenty to thirty pounds. This extension may be worn sixteen hours out of the twenty-four of each day and night. I can conceive of no more efficient mode of elongating a curved spine than this; yet it is far from a powerful agent. It is employed, however, simply because we possess no other.

How is the attempt to be made to restore the projecting ribs to their natural form and relations? Can we materially influence the form of a bone by increasing the power of its muscles? Can we straighten a twisted bone, or curve a straight one? There is but one mode with which I am acquainted, and that is by pressure; firm, hard, and continuous pressure. For this purpose a large pad, covered with soft leather, arched to fit the projecting curve, should be employed, and fixed by means of a screw, passing through an upright, fastened to the bedstead. This pressure will prove agreeable, rather than otherwise, by the support it affords. This first and most important seat of pressure requires, of course, counter-pressure on the opposite side of the body. There are two situations in which pressure may be made without pain or much inconvenience; viz., on the hip and on the base of the neck immediately above the clavicle, both of which must be fitted with screws and pads corresponding with the opposite, but of smaller size. The first pad should be so made as to press, not in the transverse or horizontal direction, but in that obliquely forwards; the two latter may press horizontally. This lateral pressure should be maintained as firmly as the patient can bear, for much of the success of the treatment depends on its efficiency and permanence.

A third part of the treatment consists in enlarging the capacity of the diminished half of the thorax. We have no instruments for this purpose—no agents by which the ribs can be drawn outwards. Difficult enough is the task of forcing in the projecting ribs, but far greater is that of urging those that are depressed in the contrary direction. Having no artificial means at our command, we

must draw on the resources of nature, and compel her aid. The diaphragm and intercostal muscles are the primary and only important agents by which air is carried into the lungs in respiration. These powers are exercised contemporaneously during health; but in the cases under consideration, nearly the entire of the action is sustained by the diaphragm alone, consequent on the reduced and weakened condition of the intercostals. If we can arrest, or at least control, the action of the diaphragm, the intercostals must be roused to action, and we endeavor to effect this object by compression of the abdomen. The application of a thick and soft pad of lint or cotton wool, or a pad containing bran or horsehair, should be made by means of a bandage passing across the abdomen; and it may be drawn sufficiently tight to produce a somewhat labored respiration. By this means we control the action of the diaphragm, and throw the duty of inspiration on the intercostal muscles, which will gradually respond to the influence of this compulsory action, and acquire force; and at the same time the compressed cavity of the chest will gradually expand. But this, though a work of months, will repay the effort, and, by perseverance, the chest will be moulded into a greater or less approach to its natural form, according to the tolerance of the patient, and the activity of the surgeon.

This principle of treatment should be persisted in till observation of the back, to be occasionally made, obtain conclusive evidence of positive improvement. Nor, indeed, should it even then be desisted from, but rather modified as we approach, at the expiration of from eighteen months to two years, or possibly more, the period for entering on the second stage of the treatment.

This treatment consists in bringing into action the muscles which were reduced in power at the commencement of the restraint. The condition alluded to involves the muscles of the back, and the large muscles connecting the arm with the trunk. Of the former we must bring into action the *levator spinæ*, and of the latter, the *trapezius*, *serratus*, *latissimus dorsi*, *rhomboidei*, *levator scapulæ*, and the *deltoid* and *biceps*.

For the purpose of exciting to action the first of these, the levator spinæ, the patient should be placed on her face, and desired to raise the head and trunk off the bed, and to support them in this attitude for a few seconds. This exercise should be repeated many times in each day. In the course of a few days, a ring of shot, of

the weight of about four or six pounds, should be fitted on to the back of the head, for the purpose of increasing the effort of raising the head from the horizontal line, and should be applied continually during the exercise. At the expiration of a month, more or less, the same exercise should be performed on an inclined plane, with the head placed below the level of the body, in order to increase the range of action, and the effort may be made of slightly increasing duration each day. By such means the two levatores spinæ muscles will increase in strength and magnitude, and will tend to give a more equal support to the spine than it has been long accustomed to from them.

A certain amount of exercise of the serratus and rhomboidei is quite compatible with rest in the horizontal position, and may be effected by means of a pulley screwed into the ceiling of the room, through which should pass a line, attached to a weight of as many pounds as can be raised by an effort; this weight may fall into a padded basket, to prevent noise. The rhomboid and serratus muscles are brought into action by retracting the arm, when carried forward to its fullest stretch; but the arm should not be bent for this purpose, or we employ another series of muscles, the biceps, &c. The duration of this effort, like the last, should be determined by the power of endurance. The longer and the more frequently it is continued the better; and in this example, as in the last, the weight should be increased with reviving power in the muscles.

By such exercises all the muscles may be strengthened in their action, and none should be neglected. But it must be fully understood, that this important stage in the treatment should follow rest and pressure, and that it can have little, if any, influence on the form of the chest. The muscles of the lower extremity may also be brought into action in the horizontal position; but generally this is not necessary, for on resuming the upright position, and on throwing aside restraint, it is surprising how comparatively little power of locomotion is lost. Any and every kind of exercise may now be adopted.

The treatment I have above recommended, refers, as I have said, to cases of curvature of the spine, in which distortion has advanced considerably. In less advanced cases, in which the defect of form is hardly perceptible through the dress, simpler measures may answer the purpose of preventing increase. Even in such examples, the removal of the superincumbent weight for a large portion of each

day is most desirable, by the patient's lying down: great care should be bestowed on position, and the weaker leg brought into more active occupation. A very useful agent of treatment, which I very frequently employ, consists in a weight applied on the head, in the form of a ring or coronet, containing shot, varying in weight from four to eight or ten pounds. The weight may be sewn in a tube of strong linen or ticking, and tied under the chin. So long as the weight is worn on the head, the facility of transmitting it to the ground without effort almost compels an upright position of the trunk, and it may be worn, whether during exercise or while sitting, for many hours during the day. It is this habit of carrying weights on the head that renders people accustomed to this practice so particularly upright, which is rendered so manifest in market-women and soldiers. In fact, it is the only position of ease, for the moment the body is inclined from the perpendicular, the muscles are brought into action in order to support it. If the patient, divested of her clothes down to the loins, be placed in the sitting position on a stool, with the weight applied on the head, and desired to carry the head laterally and circularly in all directions, the influence of these movements on the spinal muscles will be readily observed, and this, indeed, forms as good an exercise as I can suggest, particularly if the patient be required to bend the head somewhat forwards.

But, however active these exercises, it should be clearly understood, that they can have no influence on the ribs if protruded, or replace the elevated shoulder if dependent on this cause. Here we treat what may be strictly called curvature of the spine. In the more advanced cases we treat *curvature of the ribs.*

The question of tenotomy is occasionally raised in the treatment of curvature of the spine, and there is no doubt that the operation may be resorted to with benefit in suitable cases. If the lumbar curve be very marked, indicated by a tight cord passing upwards, parallel to the lumbar vertebræ from the pelvis towards the angle of the last ribs, it may be divided with advantage. But in dividing the tendinous covering of this part of the levator spinæ, no advantage can arise from dividing the muscle also. If the knife be introduced on the outer side of the muscle, and passed in to the spine, with its flat surface applied to the muscle, and its edge then turned downwards, the tendinous surface of the muscle may be divided, and nothing more. It will be immediately observed that the spine

may be brought out into a straight line in this region. Still it is an operation the benefit of which has been largely overrated, although I think I have often seen it useful, when applied to well selected cases.

As regards the ultimate treatment of curvature in cases in which much yet remains to be done in the form of restoration, benefit may be derived from a support raised from a belt of strong leather encircling the pelvis, the pressure of which is regulated by a screw. This instrument is made by Ferguson, and when fitted to the person is scarcely observed through the clothes. Its influence is not, however, entirely passive, for by its continued pressure it retains the spine in a position most favorable to ultimate improvement.

CHAPTER XX.

TALIPES OR CLUB-FOOT AND ON SOME DEFORMITIES OF THE FEET AND HANDS.

The treatment of this form of distortion constitutes one of the greatest triumphs of modern surgery. By its agency it may be reasonably asserted that already thousands of young persons have been qualified for active occupation in life, who would formerly have been consigned to perpetual lameness, and to the compulsory selection of pursuits of a more or less sedentary kind. In restoring such persons to activity, the surgeon restores them in no less positive a degree to health, and to some of the greatest enjoyments of life. The history and gradual progress of this interesting branch of surgical science are foreign to this work, and, therefore, I proceed to the consideration of the disease, its nature, causes, and treatment.

Club-foot, or *talipes*, is the result of a morbid condition of one or more of the muscles moving the foot, whether in flexion, extension, abduction, or adduction. It owes its existence to any cause which may interfere with the sufficient supply of nervous influence, or arrest the current of nutrition to the muscles. This may be produced by a local, or constitutional, or a general cause. An attack of fever in a young person may be followed by a loss of power of one or more muscles. The spine may be injured; or the spinal centre of the nervous system, as in the process of dentition, may be the seat of irritation; long confinement, repeated attacks of muscular rheumatism, local violence to muscles, each and all are sufficient to produce it. Any of these causes may occur in early life, and many in early childhood, to explain the loss of contractile power in any given muscle, or in any number of them; and the loss of utility of one muscle infers that of its antagonist also, for these muscles of the extremities will not long retain their healthy action, without antagonism.

Talipes is also a congenital disease; that is to say, that children, by virtue of their position in utero, exhibit at the moment of birth a

contracted relation of the foot to the leg, varying in degree in different subjects. In children of ordinary force of circulation or of nervous power, this slight distortion is rectified by every day's growth, and the foot gradually assumes the attitude required for supporting the weight of the body, while in others, wanting these powers, the distortion increases as the child advances in age, and when once the muscles succeed in drawing the foot to the side of the tibia, instead of directly against it, those of the side opposite to that to which it is drawn, acting to a disadvantage, lose their power of antagonism, and the disease becomes permanent. The evidence of imperfect nutrition, which now exists in the relation of an effect as well as a cause, is obtained from the wasted condition of the muscles, and from the low temperature of the limb.

The proximate cause of talipes refers itself not only to the muscles, which being reduced by inaction, have become rigid and contracted, and in which the contractile fibre is greatly diminished in proportion to the tendinous material, which enters largely into the composition of all muscles, but also to the ligaments and to the bones themselves, both of which gradually bend under the influence of the unnatural conformation of parts. The ligaments are distorted, the plantar fascia contracted, and the bones reduced in size and thickness, the limb is shortened as the disease advances, and the tibia is attenuated in structure, in obedience to a universal law, which requires active employment of structure, as the sole condition of development and health.

Talipes is divided into three forms. The most common is that in which the foot is drawn inwards, by the action of the tibialis anticus and posticus, and it is called *talipes varus.* This form is usually congenital, and owes its existence to the position of the child in utero, as has been stated by Mr. Tamplin. The second is *talipes equinus*, in which the foot is extended, the heel being raised by the gastrocnemius and soleus muscles. The third form is *talipes valgus*, in which the foot is turned outwards by the contraction of the peronei attached to the outer side of the foot.

Distortion of the foot, especially in those examples of the talipes varus which are congenital, may be rectified by the application of pressure applied in the opposite direction to that in which the foot has a tendency to turn, also slight cases of talipes occurring in children after fever or other forms of illness. Such examples may be treated by daily extension, by friction, and tonic medicine; but in

confirmed cases, nothing short of the division of the tendons will effect permanent good. Any tendon may be divided that presents an obstacle to the natural position of the foot, and for this useful operation we are indebted to Dr. Stromeyer and to M. Delpech.

When the division of a tendon is made by the knife, a new material, that may be termed callus, is formed in the interstices of the section, which unites the opposite ends. This material is susceptible of elongation, to an extent commensurate with the loss of length sustained by the muscle, and probably more, if required. By this division of the tendon of any given muscle, we destroy the tension on its antagonist, and give it the opportunity to exert its power of contraction, and of recovering from its state of long inaction; or, at least, we can influence the less organized structures, by placing the foot mechanically in the position most calculated to support the weight of the body.

First. In order to effect the object without injury, the tendon or tendons to be divided should be exposed as little as possible. The operation is a subcutaneous one. Mr. Paget has confirmed the fact, previously known, that exposure of the tendon is often followed by inflammation and suppuration of the wound. Moreover, the tendon itself may separate by exfoliation. The division should be made without violence or displacement of the parts divided. Secondly. Immediately after division, the parts should be healed by the first intention, by being brought into contact with each other, and maintained at least during the entire period required for their union. Thirdly. Inasmuch as the elongation of the tendon can only be obtained by that of the new fibrous material intervening between the divided ends, so the extension of the tendon should be gradually and carefully made to the length requisite for recovery from the distortion, before the new material has become firm. Fourthly. When this degree of extension has been effected, the foot should be fixed in the position, and so retained until the new substance has acquired the requisite degree of consolidation.

Dr. Little has remarked, that the left foot, in cases of double talipes, is generally more thoroughly affected than the right; but this must be accidental. Of the three forms of the disease, that of varus is the most common, this being the form incidental to the period of birth, and that of valgus is the least so, this form occurring, though less frequently, at the same period.

In order to ascertain the immediate cause of the deformity, the

foot should be forced into its natural position, or into some approach to it. By this process the tendons causing the obstacle will stand out prominently, or may be felt in a state of great tension under the skin. In talipes varus, the tendons of the anterior and posterior tibial muscles will often require division; in pure talipes equinus, the tendo-Achillis; in talipes valgus, the peroneus longus brevis, and tertius. It is needless to describe the course and relation of these muscles to the ankle-joint, because, if they exist as the cause of distortion, their tendons will stand out prominently enough to point to their own course. If description be required to indicate their position to the surgeon, the cause must be looked for, and the remedy also, elsewhere.

The knife employed for division of these tendons is necessarily small, and should be delicately made. The blade should be nearly straight, with the edge turned up at the point, towards the back, and the cutting edge should not extend beyond eight or ten lines in length; and, inasmuch as the blade is useless beyond the cutting edge, so it should stop at that point, and be connected to the handle by a round stalk of half an inch in length. These proportions will give length sufficient to deal with any tendon requiring division about the foot of a child. If the blade be too acute at the point, it will pass through the tendon without giving evidence of its course to the hand, should the knife be directed against, instead of underneath it, and by having the blade short, the skin will be cut only in the act of introducing it.

After the division of the tendon, the foot is bound up in a common roller, until two or three days after the wound is healed. At the expiration of four or five days, the foot is placed in Scarpa's shoe, made of thin flexible tin, by which the extension of the divided tendons is rendered permanent.

The operation is very simple. The foot being well examined, we ascertain, by placing it in its natural position, the locality of the contracting agent. The foot is then held by an assistant in such a position as to render this cause as prominent as possible. The knife is then introduced underneath the tendon, with its flat surface towards it; and in withdrawing the knife the tendon is cut slowly asunder. If we have hit the cause aright, the tension on the foot will be immediately relaxed, and the sensation caused by this relaxation is sufficient evidence of the completion of the division. In withdrawing the knife, its back should be pressed against the wound,

and a depression between the divided ends of the tendon will confirm our almost certainty of the division.

In talipes varus we divide the tibialis posticus. It is better to introduce the knife about two fingers' breadth above the malleolus, in order to avoid the posterior tibial artery, which I have seen divided, and give rise to troublesome hemorrhage. In confirmed or advanced cases of this form of talipes, other tendons will require division, such as those of the tibialis anticus, gastrocnemius, and sometimes the plantar fascia; but it is not necessary, nor even desirable, that all be divided at one time.

Cases sometimes present themselves of a compound nature, formed by a combination of either of two kinds, such as the equino-varus, or equino-valgus. It is needless, in such or in any cases, to lay down a rule as to the tendons to be divided. Any tendon may be divided, or, indeed all, consecutively, provided the foot continue deformed after the division of one or more. The earlier the treatment be undertaken, the better. I believe Mr. Tamplin, of the Orthopedic Institution, has performed the operation of tenotomy on a child five weeks old; but I am inclined to think this age objectionable, unless required from some specific cause. I prefer to select from two to three months, and before the period of dentition.

Cases of talipes require a great deal of care and trouble in the after-treatment, of which the operation constitutes but a small fraction. The child should be visited every day, unless placed under the observant eye of an intelligent attendant. A period of from six to twelve or eighteen months is requisite for the cure of extreme cases of talipes, equinus and valgus, while for early cases of varus, from three to four months will generally suffice.

On Cases of Paralysis of the Elevators of the Foot.

In the cases of old paralysis of the elevators of the foot, which we so frequently meet with in advancing boy or manhood, much benefit may be obtained by judicious treatment. These cases are allied to talipes equinus. Here the foot is distorted, but in a slight degree, though its growth and that of the leg have been interrupted by want of action. The muscular agents of the body, and especially of the extremities, are so balanced as to obtain perfect rest only by their conjoint presence. Muscles, in themselves antagonistic, always wait on each other's actions. There would appear a

mutual consent in this, for the purpose of controlling the movements of the limb in all its variety. So long as the flexor muscle continues inactive, the extensor is in a state of repose. But on the occurrence of the slightest degree of contraction in the flexor, this repose is disturbed by the exercise of the controlling or regulating power of the opposite muscle, which may be supposed to watch with a vigilant eye, lest a march be stolen upon it. In the cases I allude to, which may be taken as the type of many others, the tibialis anticus is the erring muscle, the failure of which may often be dated back to the early period of teething. The defective action of this muscle gives a peculiar gate in progression, which must be well known to all medical men, but who may not be so familiar with the nature of the disease itself. In the ordinary movement of the leg forwards in progression, the foot is raised by the tibialis anticus and peroneus tertius, as it is called. Without their aid the toes fall in the act of stepping, and are dragged along the ground, unless, by an effort at partial abduction of the leg, the limb is thrown outwards with a kind of jerk, into the segment of a circle; and this is just the movement which we recognize in persons who have lost the power of these muscles. The consequence of this loss is, that the muscles of the tendo-Achillis, having no antagonism, gradually raise the heel, and fix the foot in permanent extension. The weight of the body is thus received on the ball of the great toe, the calf diminishes, and the whole leg dwindles.

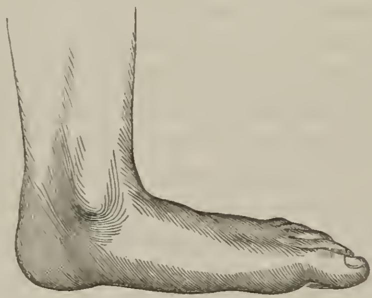
This condition of the limb admits of great improvement by art. The difficulty lies in placing the foot flat on the ground, consequent on the tension of the tendo-Achillis. The first step to be taken is to bring the heel down by dividing the tendon. This division may be made anywhere within two inches of the os calcis; but it is more contracted in breadth at the distance of about one inch above its insertion into the bone, and this is the place I usually select for the purpose. The tendon being divided, the foot regains its mobility on the tibia at the ankle-joint. A bandage may be applied, and the union of the tendon, elongated by its new material, completed in the manner above described. The second consideration relates to the requisite means of bringing the foot up, by supplying the loss of the tibialis anticus muscle. This is effected by a band of vulcanized India rubber, which is attached to the front of a firm and well-made boot, and carried up the leg to a strap applied around the upper part of the calf. Here the elastic substitute for the muscle is fixed. In

the act of walking, the point of the foot is efficiently raised by the band, when drawn to the required degree of tension, and the gait of the child is entirely altered. The band may be completely concealed from view by passing within a boot. The circular movement of the leg and the accompanying jerk, which are instinctively adopted for the purpose of raising the foot to the requisite height, are now no longer observed. In examining his person while walking, the head will be carried erect, and the movements be effected without writhing or contortion. The body continues upright, and the gait is easy and natural. In some cases the success is complete, and especially when the disease is confined to one leg; but the benefit is not so easily conferred when both limbs are affected. This treatment is especially applicable in cases of paralysis confined to the anterior tibial of one side only. In all complications the difficulty is increased. Unless a child feel confidence in the support to be obtained from, and possess entire command over the muscles of one limb, on which the weight of the body may be thrown, it is difficult to regulate the actions of the diseased limb with precision. Before proceeding to act, it is necessary that the condition of all the muscles be ascertained. In one case, having divided the tendo-Achillis and fixed the above simple apparatus, I observed that the child always leant forwards, and rested its hand on the outer part of the thigh of the affected side. A fuller inquiry proved to me that the rectus femoris was involved in the loss of power, and the success was limited. In another case, of a very interesting girl, the loss of power in the front of one tibia was opposed by that of the posterior muscles of extension of the other leg. Here, also, some benefit was obtained, but the insecurity of the two limbs was too great to render the improvement perfect. When the disease is limited to one set of muscles only, much good may be done by the application of the above principle. In the case of paralysis of the muscles which move the leg forwards in progression, the addition of a well-adjusted elastic strap, extending upwards over the knee, and attached to a belt applied around the abdomen, will supply the place of these muscles of the thigh when paralyzed, and both increase and regulate the movements of the person in progression.

Loss of the Arched Form of the Foot.

Among other forms of distortion to which the foot is liable, is that in which its arched structure is lost, and the entire foot falls flatly on the ground. The consequence of this disposition of the bones is perceived in the entire gait of the person in the act of progression, and in which the foot falls like a dead weight on the ground at every step. There are few regions in the human body more beautifully contrived for the duties which are consigned to it than the foot. In the act of stepping, the foot is advanced forwards till the heel touches the ground. The weight of the body is then thrown upon the centre, and, finally, at the moment of raising the foot, on the toes, while in a state of flexion. This alternation of surface corresponds with the form of the segment of a circle, on which the body may be said to revolve in the act of progression. So long as

Fig. 77.



the arch of the foot is retained, its presence gives elasticity to the gait. This arch may be compared to a bow, the cord of which is represented by the plantar fascia, the bow itself by the arch of bones. This fascia being rendered tense by the weight of the body, allows just sufficient play between the bones to take off the effect of the shock to the body when the foot is placed upon the ground. If the cord be relaxed, the foot falls, and the arch is lost. Such is the condition of persons the natural structure of whose feet has undergone change, whether at the hands of nature or of art.

The arched form of the foot is due not only to the plantar fascia, but most especially to the position of the astragalus, which is supported by the calcaneo-scaphoid ligament, extending forwards to the navicular bone. If this ligament be elongated, the head of the as-

tragalus, which forms the summit of the arch, descends towards the ground, and hence flattening of the foot, by destruction of the arch. This form of the foot is occasionally observed in all classes, but more especially in the lower, where it is the result of a natural conformation, but in young persons it owes its existence to the interference of art. Among the greatest offenders against nature may be classed the teachers of the art and mystery of dancing, whose course of instruction teaches the necessity of directing the toes outwards at an angle of at least one hundred and twenty, and the only reason why this angle is not carried up to that of one hundred and ninety, which completes the straight line, is the impossibility of effecting it without dislocation. This folly yet prevails. Natural form, which is identical with natural beauty, ease, and elegance of gait, each and all are sacrificed to a morbid taste as ridiculous as it is fatal to nature's own design. Nature designed the foot to be so far only everted from its fellow, that the toes might be kept free from collision in the act of walking; but the dancing-master, more learned in his vocation, requires this angle to be largely increased, and the consequence is, that we observe in all students of this noble art, a distortion of the foot proportioned to their observance of the rules of art. In all persons devoted to the study and practice of elaborate dancing, whether for pleasure or profit, the foot is more or less flattened, and the astragalus projects more or less inwards. The remedy consists, first, in avoiding the cause, and, secondly, in habitually retaining the foot in a straight position on the tibia. When the foot in this straight position appears, as it often does, somewhat everted, a piece of thin cork should be introduced into the boot, or, what is better, the sole should be made about a quarter of an inch thicker on the inner than on the outer side of the foot; and these measures will prevail, in the course of a few months, in reinstating the foot in nature's own position. Before resorting to the remedial agency of position, we should clearly understand that the deformity is a disease, and not a malformation. I was consulted about a little girl, whose feet were considerably deformed in the above manner. Finding no benefit to arise from treatment, I made an application to the mother to see the father's shoes, and this led to the desire to see the feet also, and in them lay the root of the evil. Treatment was useless. I saw the daughter of a gentleman, who had just returned from a *finishing* school. The same deformity had made some progress in both feet. Without making any other

inquiry, I said, "I congratulate you in having obtained the prize at school for dancing." She looked up in surprise, and inquired how I had obtained the knowledge of the fact. The main fact I knew from the form of the foot. The secondary fact I guessed at, and guessed rightly. The absence of the cause, viz., the resort to the natural and unrestrained position of the feet succeeded in six months in the entire removal of the evil.

There are some curious facts, yet unexplained in pathology, connected with this subject. A young man of twenty years of age applied at St. Bartholomew's Hospital, who had become quite lame from the gradual falling of the astragalus of both feet. The disease had appeared within six weeks or two months of his attendance: he could give no account of the cause, and the pain of which he complained appeared rather an effect than an attendant symptom, on the change of structure. This alteration in the organization of the foot appears to resemble in its nature that of the knee-joint, which, without apparent cause, is forced inwards, rendering the subject of the disease what is called knock-kneed. One articulation or both may be affected. I have known it make its appearance in early manhood without any explicable cause, and increase until a limb has been rendered almost useless for the purpose of progression. One is naturally inclined to attribute the change of structure to relaxation of the internal lateral ligament; but such relaxation would by no means explain the mystery. I have heard it referred to absorption of the external semilunar cartilage; but the thickness of that structure is quite insufficient to explain the great degree of obliquity, nor can I understand the nature of the deformity in question, except by inferring disease of the bones themselves, of which I could obtain no local evidence.

On Spurious Anchylosis.—While on the subject of joints, I may relate the result of the treatment I employed in a case of supposed anchylosis of the knee-joint. The disease occurred in a young woman of twenty-five years of age, who, having had rheumatic inflammation of the knee-joint, had visited many of the London Hospitals, during her three years of suffering, in the hope of obtaining relief from swelling, pain, and immobility that followed the attack. She wished me to remove the limb, which I declined. I employed local friction and a local vapor bath for some two months, or longer, without advantage: the patella was fixed, as were the chief bones of the

articulation. The knee was bent to about a right angle and a half, or an angle of 135°. Under the influence of chloroform, without which I conceive such an attempt would have been inadmissible, I leant my entire weight on the joint, and the adhesions, which were entirely fibrous, gave way audibly, and the limb was placed straight. This patient, though still under treatment, has every prospect of a useful limb, even though the joint remain permanently inflexible.

This expedient has been recently adopted by Mr. Stanley with great success, in many cases of spurious anchylosis of the elbow and other joints, in several of which he has succeeded in partially restoring the limbs to their former utility. There is no doubt that many such cases would formerly have been consigned to amputation.

Cases of contracted Fingers.

This disease is often of serious inconvenience to the subject of it. Chronic inflammation attacks the fibrous tissue of the theca, and extends to the skin and palmar fascia, the effect of which on the finger is to produce a permanent contraction, with hardness along the line of the tendon, and more than one finger may be involved in the contraction; but the disease mostly commences in the little and extends to the ring finger, and both hands may be similarly affected. The division of the fibrous structure is followed by reunion of the parts, and no benefit is obtained by the experiment. The attempt at recovery of the finger should be set about very systematically, or success will not attend it, and the entire hand may be crippled for life. The hard skin and the fascia underneath it must be dissected out, and if the tendons be involved, they should be divided; but probably the division of one will be sufficient; the finger may then be straightened, and fixed upon a splint, until the healing process is completed, and for some time afterwards. It is very desirable not to denude the exposed tendons of their cellular investment, or they will be liable to adhere to the skin in the process of cicatrization.

Web-fingers.—The fingers are occasionally connected to each other by integument passing between them, and preventing their use singly. If the web be simply divided, the disease returns almost inevitably, whatever care be taken to prevent it. Mr. Liston suggested an excellent mode of curing this disease. He introduced a

ring into the web at the root of the fingers, and allowed the opening to cicatrize in the manner of the ear-ring, and he then divided the web, and rolled the fingers separately. I have never had the opportunity of adopting this treatment, but I have no doubt of its success.

CHAPTER XXI.

ON THE OPERATION FOR PUNCTURE OF THE INTESTINE IN CONSTIPATION, AND FOR IMPERFORATE ANUS IN INFANTS.

Cases of constipation that resist the influence of ordinary treatment by means of purgatives, enemata, &c., are often dependent on mechanical obstruction in some part of the alimentary tube.

Such obstruction may be dependent on various causes. First, on strangulated hernia; secondly, on intussusception of the intestine; thirdly, on the occurrence of an abnormal twist of the bowel; fourthly, on the formation of a bridle of lymph, the pressure of which may insulate the contents of a portion of intestine; fifthly, on the external pressure of malignant tumors; and, sixthly, on stricture. Of such causes, the first and two last involve disease of both the large and small intestine; the three remaining are limited to the small intestine only. When the disease is seated in the small intestine, whether jejunum or ilium, the symptoms are more acute and more rapid in their consummation, consequent on their higher degree of vitality, than that of the large intestine.

Of the causes above alluded to, hernia and stricture are by far the most general, and on such a case presenting itself for treatment, no sooner does the suspicion of its nature occur to the mind of the medical attendant, than it becomes his duty to examine the regions in which hernia, whether inguinal, femoral, or umbilical, ordinarily occurs. If the examination, when fully made, prove inefficient, the inquiry should be continued in reference to other causes; and of these stricture is by far the most frequent.

The evidence pointing to such form of obstruction is generally obtained—first, from the absence of primary inflammation of either the intestine or the peritoneum, of which constipation is a symptom; secondly, from the gradual approach of the constipation, which may have existed in a greater or less degree for many months; thirdly, from the absence of considerable pain on pressure; and, fourthly, from the consciousness on the part of the patient of her inability

to act on the lower part of the rectum by the agency of the abdominal muscles. I have employed the feminine pronoun, because it has happened to me to have observed and attended such cases with far more frequency in the female than in the male sex. As the symptoms advance, the stomach rejects food; the intestines become distended with flatus, and the bowels writhe in a painful but unsuccessful effort to force the passage. These efforts become less frequent and less powerful, till the patient dies exhausted.

Such is the general history of cases of mechanical obstruction to the alimentary canal from stricture, proving fatal to life.

Stricture of the bowel is more frequently seated in the large than in the small intestine, and occupies the sigmoid flexure of the colon more commonly than any other part of the canal. The presence of the disease may be occasionally felt by pressure on the parietes over the left iliac region. But evidence of its nature must be obtained from every productive source. If the patient be advancing in life; if constipation has been, perhaps for months, an attendant evil, and the obstruction gradual, yielding only to the daily influence of powerful aperients, or to enemata; if there exists no evidence of recent inflammation, no local pain, we may generally infer correctly that the large intestine is the seat of stricture within the gut, or of pressure without, of scirrhous character. This is not the product of recent disease, of contraction of the canal, from common thickening, the result of inflammation, but from deposition of cancerous matter in the submucous tissue of the intestine, involving the entire structure of the bowel; and it is often in such a case that the opinion of the surgeon may be required to determine on the feasibility of opening the intestine above the stricture, and to form an artificial anus.

The desire to preserve a human life is, undoubtedly, a very powerful motive in favor of an operation, and if life could be preserved by such means, it is the duty of the surgeon to undertake it at any cost to himself; but we must distinguish between the consequences of an operation that will *prolong*, and an operation that will *preserve* life; in other words, that will effect an absolute recovery. The intestine cannot be punctured without some danger to the life of the patient, from the consequences of the operation itself. The mere act of puncturing the bowel entails, perhaps, no positive danger; but it must be recollected, that before resorting to this *anceps remedium*, the patient is necessarily reduced in strength, by the long

subversion of the abdominal functions, by the loss of food, and by the agency of remedies employed during many days for the purpose of forcing a passage, both cathartic and counter-irritant. If the operation of puncture be proposed with a view to preserve life, it must be recollected, that in opening the intestine, we leave behind a malignant disease, that will increase, and probably ere long destroy the life that has been temporarily extended. To leave behind such a disease on the back of a large and serious operation, is not very consistent with scientific surgery, and certainly cannot be recommended, especially when we consider the discouragement given to the cause of operative surgery, by the occurrence of a fatal result, and the loss of confidence entailed on those who are shaken in resolution from submitting to an operation, which may present a far better prospect of success. If the puncture be proposed with a view to take the chance of prolonging life for an uncertain term, which, under circumstances, may be of especial value; if the case be clearly and honestly stated to the patient or the friends, as one likely, in all human probability, to become fatal within a given time, say one or two weeks or a month or two months, for the duration is quite uncertain, then, and then alone, a puncture is warrantable.

It is important that the surgeon satisfy himself of the nature of the disease, if practicable; but this knowledge can only be obtained with any approach to certainty when the disease is situated within reach of either the eye or the hand. A great effort should be made to effect this object; and when seated in the lower part of the colon, in the sigmoid flexure, or in the rectum, it may be either exposed to view, or the finger may be brought into contact with it. For this purpose the sphincter must be dilated to its fullest extent, and the hand passed into the rectum. If this object, so important, require it, the sphincter may be divided backwards to the coccyx, without pain or hemorrhage. If dependent on scirrhous contraction of the colon or rectum, a cone-like projection of the membrane will be immediately felt, pointing downwards, with a depression in the centre. If the disease assume this character, we may at once abandon the hope of benefit from an operation undertaken for any other purpose than that which contemplates a possible and temporary extension of the term of life.

Such an attempt may become warrantable for various purposes, such as the distant absence of a relative or friend, in an interview with whom something more than affectionate interest is in-

volved; for how much of the future happiness of a surviving individual may not depend upon the confidential communication made on a bed of death? or again, the distribution of property may be involved to a large extent, which may be diverted from its legitimate channel, or may be acquired, should the patient survive to a future day, beyond which an operation might in all reasonable probability carry him. If life, under such circumstances, is desired by the patient and his surrounding family or friends, I do not think a surgeon should hesitate in refusing the benefit of his co-operation, whether the motive be founded on moral feeling and affection, as in the case of absent relatives, or on the question of property. With respect to the operation itself, the first question relates to the locality, and here it would appear desirable that that region should be selected in which the intestine is most readily punctured. Other considerations, however, occur to interrupt a hasty decision on this head. The intestine may be exposed in the left lumbar region, as in the operation for tying the common iliac artery; and looking to the future comfort of the patient, and the nature and office of the opening about to be made, this region has advantages possessed by no other attainable one. But it must be recollected that the colon in this situation lies at a distance from the surface, a distance of some two inches at least, and that a puncture into it could not be made in safety without careful and prolonged dissection, and that a tube so introduced must be necessarily retained along a deep and suppurating wound, whereas an opening in front is made through thin parietes and into a distended bowel, the outlines of which are apparent to the eye. I think we ought to lay aside all consideration of future comfort for the sake of the important question of temporary safety. If the disease be uncertain in its nature, and present a reasonable prospect of ultimate recovery, that situation should be preferred which offers less objection on the ground of comfort and cleanliness; but in the example above given, every other consideration should be sacrificed to safety, and I conceive that there can be no doubt raised as to which locality the preference should be given. It is true that the front surface of the body is more highly organized, and that operations on the back are less serious in their consequences; but this is not a question involving parietes without, but organs within; and if the intestine has to be opened with a view to form an artificial anus, I conceive that the lower the puncture be made the better, not merely with

regard to the length of the remaining tube, but with that of the vitality of the intestine itself.

As regards the mode of puncture, if made through the anterior wall, that point should be selected which indicates the greatest degree of prominence of the bowel, which in such cases is always both dilated and thickened by its long expulsive effort. The ear and the stethoscope should be brought into requisition, and the outline of the bowel well ascertained by percussion. The integuments may be divided to the length of an inch or more, and the abdominal muscles cut asunder to the extent of the outer wound. A large curved chain trocar in a canula, with the point directed upwards along the tube, should be introduced quickly into the bowel, and the canula retained during the escape of the contents, and, indeed, so long as local disturbance does not ensue. The canula should be of such length as to prevent its escape from the bowel, as the contents flow off, and the gut contracts in diameter.

In the operation on the intestine in the lumbar region, the external incision should be made from the point of the last rib downwards, to, and along the crista ilii, the muscles should be divided to a less extent, and the bowel punctured with a long straight trocar, the canula of which should be retained on the same terms as in the operation in front. The necessarily greater extent, both on the surface and in depth, of this operation, is the chief element among the objections to its performance.

ON IMPERFORATE ANUS.

Associated somewhat, at least in principle, with the above subject, is that of obstruction to the alimentary tube in newly-born children, caused by imperforation of the anus, examples of which are not infrequent in extensive obstetric practice. The want of continuity of the canal is usually unobserved for a day or more after the birth of the child, when the absence of discharge of the meconium attracts the attention of the nurse, and the defect is observed. Under some circumstances, however, the absence of the anal orifice may be detected at birth; viz., when the natural discoloration of that surface is wanting. Under all other circumstances, the defect is unknown, and of course unsuspected, until the repeated but futile efforts of the child to force the contents of the intestine expose the

abnormal condition of the canal. Imperforate anus, as it is termed, presents itself in three degrees of defective organization. In the first we find a simple closure of the external orifice, by a band or membrane passing across and occluding it. In the second, the tube of the intestine appears closed to the extent of the sphincter muscle. When I say closed, I mean that the gut is wanting as regards the mucous coat, and the muscular coat has a doubtful connection with the sphincter muscle. In both of the above examples, the external sign of the orifice, so far as relates to its form and color, is present; and without a closer than ordinary inspection, the condition of the part would pass unnoticed either by the nurse or by the surgeon. In the third example, we find not imperforation, but deficiency, the entire absence of the intestine, from half an inch to two inches in length. Under these circumstances, the external signs of an orifice, and even the sphincter muscle, may be totally wanting. Indeed, it is often combined with imperfect development of the corpus spongiosum. In considering the duty of the surgeon, we cannot hesitate in our attempt to establish an orifice by operation; and convinced that the death of the child is the certain issue of failure, we must leave no effort untried that prudence dictates, to effect it. The child should be laid on a pillow placed on a table, and brought to the light; the whole abdomen should be bared, and the perineum and anal region carefully examined. If the brown external mark of the anus be well defined, we have reason to hope that the defect may not be great, and *vice versâ*. The point of the finger should be placed on this surface, and the other hand laid on the abdomen, for the purpose of compression of that cavity.

The application of the hand will often excite the abdominal muscles to contract, and if not, its pressure will tend to force the contents of the intestine down into the rectum. If the tube of the intestine be continuous up to the orifice, or even to the sphincter, the impulse will be perceived by the finger below. Whether it is or not, an opening should be made. If it be perceived, and it become obvious that a simple band or thick membrane forms the only obstruction, it should be divided with a small scalpel. If it be not felt by the finger, the external parts should be drawn tightly by an assistant, and the orifice divided to the depth of the sphincter, or about one-third of an inch, taking the greatest care to follow the exact line that the intestine usually occupies. The finger should then be oiled and passed into the opening thus made, and the hand pressed

on the abdomen, as before. A trocar is now to be employed, in size about intermediate between those employed for ascites and hydrocele, and the canula being pressed on to the bottom of the wound, the trocar is to be carried beyond it, the depth of the puncture being regulated with great nicety by the thumb-nail pressed on the shaft of the instrument, first to the extent of half an inch, then to an inch, and even to an inch and a half. Should a puncture of this depth fail to obtain meconium, the case may be deemed hopeless, so far as regards the prospect of establishing the continuity of the tube. To proceed further in such a case would rather depend on the value attached to the life of the child by the parents, and the surgeon may, without being chargeable with indifference or neglect of duty, decline further interference, because the issue of the case is not determined, nor life necessarily preserved by a successful puncture under these circumstances. The difficulty is yet before us, that of retaining the orifice made by the trocar. If the value of the life of the child be specifically great, arising from its future relation to property, &c., another effort may yet be made, and the trocar again resorted to, and introduced in more than one direction. Should this effort fail, nothing remains but to open the colon through the abdominal parietes, and I can hardly conceive the circumstances which would justify such a proceeding. Should meconium follow a successful puncture by the trocar, through the sphincter, a large urethra bougie should follow its evacuation, and especially so if the canula employed be small. The retention of the bougie, or a silver spring, which is preferable, will demand all the ingenuity of the operator, arising from the great difficulty of retaining the orifice and the tube beyond it patent. I have succeeded in obtaining meconium after a puncture of more than an inch in depth, on two occasions, but both children died from this cause. In neither case was I responsible for the more difficult portion of the task, viz., the after-treatment. When the intestine is imperforate to the extent of a third or half an inch, ultimate recovery may be hoped for as probable ; beyond this extent it is very questionable.

CHAPTER XXII.

REMOVAL OF CICATRICES, AND AUTOPLASTIC OPERATIONS.

The principle of the operation invented or practised by Taliacotius, when resorted to with judgment by the operating surgeon, constitutes a very valuable resource against deformity of various kinds. The notorious indisposition on the part of nature to the reformation of structures identical with those which have been removed by disease or accident, under which law the skin appears as a pre-eminent example, renders the operation of Taliacotius the occasional agent of benefit, by which many persons are rendered capable of being restored to society, and of being relieved from very severe forms of wound, if not of physical suffering. This principle consists in transferring healthy integument to fill a space in which it has been lost; and although the principle is scarcely maintained in the examples in question, yet the term is equally applied to the junction of fissures occurring in the mesial line of the body, whether the result of accident, of disease, or of congenital deformity. On the Taliacotian principle, more strictly applied, we perform the rhinoplastic operation, that of the formation of a new lip or new eyelid, and also that which attempts the restoration of the external outline of the body, by the substitution of new skin after the destructive action of burns. Under the same title, somewhat incorrectly applied, we perform the operation for staphyloraphy, or hare-lip, and that for union of the lacerated perineum in women. Of these operations I have already described several under their respective titles, and I proceed to speak of its application to cases of injury from burns.

It will readily be granted, that no disease, or no description of deformity, to which either youth or age is subject, can be more distressing, and I may say more revolting, than the occasional destruction of the human lineaments by fire. Occurring in early childhood, these unfortunate sufferers, after the sacrifice of one or two years to what is termed their recovery, present themselves at our public hospitals with the total loss of the anterior integument of the neck

and lower portion of the face. The chin is adherent to the sternum; the chest and face are seamed with old scars; the lower lip is drawn downwards into permanent eversion, giving the appearance of continued protrusion of the tongue. Two or more bridles, of from one to two inches in depth, run down from the face to the front of the chest. The growth of the lower jaw and its appurtenances is arrested, the lower teeth project; the lower eyelids expose the hollow of their concavities; the mouth itself is concealed from view by the lateral bridles of skin, which are rendered still more prominent, whenever the attempt is made to raise the head by the action of the muscles at the back of the neck, and saliva unceasingly flows from the mouth. The entire face participates in the distortion.

What advantages does surgery present towards the removal of such frightful deformity? I regret to say, little enough, although the distress of parents will subject these unfortunate children to any form of experiment that has a reasonable prospect of mitigating the evil; and the child itself, as it advances in life, will manifest no less anxiety to devote itself to the trial. And mitigation is feasible, if too much be not attempted by the surgeon.

Before the operation, an instrument should be made to fit on to the neck, for the purpose of raising the chin, which it must support at the symphysis only, because all the base of the jaw is the seat of operation, except at the centre. I have repeatedly undertaken this and similar operations, adopting this principle for my guide, that the contraction consequent on wounds is less in proportion as the time consumed in the healing process is short; and the application of this principle will be found of value in the treatment of many cases of less deformity than the case I have above sketched, but in these examples the Taliacotian operation is not resorted to. The practice consists, not in the division of a bridle, or any tense fold or layer of skin, by one incision, but in effecting the object of relaxation by several lesser incisions. The spots to be selected must be determined by the tension. I have made on the neck, and also at the bend of the elbow, as many as eight minute incisions with advantage. The incision should not be confined to the skin alone, but should extend into the cellular tissue beneath it. The parts should be elongated from the hour of the operation, and retained most sedulously in position during the whole period of treatment, and when occurring in the neck, for many weeks afterwards. Of

hemorrhage, there is none, because all the cutaneous vessels are nearly obliterated. To such a patient, after the operation, I should give bark in as large doses as possible, with a view to force on by such artificial means the healing process.

In the severe forms of injury, such as I have described, the partial success usually awarded to our best efforts greatly depends on the healthy condition of the subject, and on the natural activity of the healing process. But that the mischief increases by time, it is very desirable that a period of years should elapse for the entire restoration of the health of the child. There is no difficulty in obtaining sound skin to supply the deficiency, and to fill the space caused by the division of the bridles, but the real difficulty consists in effecting its junction with the diseased parts, and in retaining its vitality, for the base of the wound so made is not to be deemed healthy, but on the contrary, is greatly indisposed to co-operate with the skin laid down, and to accept of its union. It would appear that the vital force of this structure is too much exhausted, in the struggle against the necessary agents of extension, to participate in the healthy actions requisite for adhesion to the structure brought into apposition with it; and when we consider the adventitious nature of this tissue, and the probable condition of its vessels, the failure of these operations is not surprising; but this failure is by no means necessary or universal. Much good may be effected by the judicious application of the resources of surgery, provided they be not overstrained. Too much should not be attempted at one time. Allowance being made for the necessary loss of substance during the future process of cicatrization, whatever is attempted should be effected entirely. The division of the skin is not sufficient, the cellular bands underneath the skin should be thoroughly relaxed also. This may be effected by the force of laceration. In several cases of this operation at the bend of the elbow, I have divided the skin, and then straightened the joint by main force (under chloroform). By this means the vessels will take care of themselves, if I may so express the principle on which this stage of the operation is effected; the cellular threads will alone yield to the extending force.

When the surface on the neck is thoroughly bared, by the head being forced backwards with a moderate effort, and the surface dissected to a depth at which bleeding is free, and derived unequivocally from minute vessels, not from the division of a single vessel of size, then the tissue is in a condition to "accept of the union" of

sound integument brought on to it, but not before. I have above remarked, that the failure of the endeavor to restore such cases is often caused by our attempting too much. I have never seen a case in which the restoration of skin fitting the entire neck has succeeded; but I have repeatedly known, and have myself been the agent of benefit from partial restoration of skin, leaving much yet to cicatrize by granulation. For this purpose the integument may be taken from the shoulder or back of the neck, and both sides must be attempted at once, or the requisite extension of one side will be unsuitable to the other. The retraction of the elastic skin, unhappily, always enhances the difficulty of the operation, by reducing the size of the flap and enlarging the wound from which it has been removed, so that it becomes necessary to raise so much integument as will leave a wound of frightful dimensions behind it. It is highly important to relieve the mouth and the jaw; but no mere section will suffice, except on the principle I have described, of making the sections very small and very numerous, and this will only apply to a flat surface, and not to elevated bridles. The completion of such operations is not the work of weeks or months, but really of years.

AUTOPLASTIC OPERATIONS.

This term is applied to operations which have for their object the bringing into contact, and uniting by adhesion, surfaces and parts, that being naturally in relation to each other, have been separated by disease, by accident, or failed to unite in consequence of defective development. The term would apply not inappropriately to the uniting by art of the two halves of the soft palate, as performed under the title I have used, of velo-synthesis. It is also required in cases of ruptured perineum in the female, where it might be termed, for the same reason, perineo-synthesis. In the act of parturition, either caused by the unusually large size of the head of the child, or by the neglect of the attendant to afford sufficient support to the perineum, rupture of the part occurs, and the orifices of the vagina and rectum are mutually involved in one common opening. If the separation be limited, the evil is not very great, and the sphincter ani retains much of its power over the intestine: when considerable, the separation is large, all the cutaneous sphincter is involved, and a greater or less portion of the larger muscle surrounding the intestine. The inconvenience and discomfort are then

very great, arising from the inability by the patient to retain the contents of the rectum; and such an evil, to a delicate woman, is little less than the loss of life itself, for she is debarred from society, and almost from any ordinary exercise. Operative surgery has too often failed in the attempt to restore the integrity of the divided structures, to justify a hope of success, except under circumstances of peculiar care on the part of the operator, and the most favorable condition of health as regards the patient. But so much depends on success, as it involves the future comfort, happiness, and even the health of the subject, that the best means should be resorted to to remove the evil. Success will, however, rather depend on the collateral than on the direct management of the surgeon, on the time selected, and, most especially, on the condition of health of the individual. It is not desirable to undertake this operation during lactation, and particularly so if the quantity of milk be obtained only by means of stimulating food. If the quantity be ample, without effort, the objection is lessened. A tonic and healthy circulation is requisite for healthy local actions, such as are required for the healing or uniting process, fresh air, and a capacious chamber. These conditions, if not indispensable to success, are important ingredients in obtaining it.

But perhaps the most important consideration connected with the subject of perineo-synthesis relates to the management and control of the expulsive power of the rectum. However perfect may be the temporary union obtained by the operation, it will prove insufficient to contend against the more powerful effort on passing the contents of the rectum, the force of which is directed so entirely against the wound. Indeed, the management of the bowels may almost be said to be the great difficulty of the undertaking. If the bowels are considerably relaxed before the operation, it cannot be said that the patient is in the most favorable condition for sustaining it, and yet any expulsive effort made during the healing process is almost sure to separate the uniting parts. This, therefore, is a part of the subject worthy the best care and consideration of the surgeon.

The large intestine should be entirely emptied by enemata, rather than by medicine, taken by the mouth. By this means no draught, will be made on the circulation, and the patient will enjoy her ordinary health.

The surfaces should be sufficiently pared of integument, be it ordinary skin, or the compound of skin and mucous membrane,

which forms in the torn structure, to bring into contact a substance sufficient to insure strength both in surface and in depth; but too much should not be attempted. One-half of an inch of union will remove the evil; but to attempt the junction of parts very largely, and most especially if carried beyond the natural line of junction, into which error inexperience may readily lead us, is to encourage failure in the result. The parts being pared of integument, the quilled suture is employed, and for which purpose the needle should be passed at a distance of half an inch at least from the margin, and carried down nearly to the bottom of the wound, in order to unite it fully to its base. Two ligatures may include the quill or bougie, or whatever material be employed, and a third thread may still be required. There is no advantage in the lateral incisions, simply because there is no strain on the wound in any position of the body. A day and a half, or two days, should be allowed to elapse before the action of the bowels be permitted. If longer, the effort required, and the consequent strain on the wound, will be greater. Assistance should be given by one or two nurses in the act, by lateral pressure of the hand.

Of the two conditions, a state of relaxed bowels throughout the treatment is preferable to constipation, for nothing can withstand a violent expulsive effort of the abdominal muscles and rectum conjointly; but the latter condition is far more favorable to union. It is important throughout the treatment to keep the vagina as dry from secretion as possible, in order to prevent its contact with the wound. This should be effected by the constant application of dry lint, or any similar and suitable material.

Cases of great interest frequently occur of artificial openings between the vagina and rectum, and between the intestine and the bladder; as also between the rectum and the urethra, in the male subject, known under the terms recto-vaginal and recto-vesical fistulæ, &c. The management of such cases involves no especial principle, whether in the operation, or in the after-treatment. It is important, as I have said elsewhere, to do our best, at the first effort, not to attempt to pare the edges of the wound, unless it be well exposed to view, to pare it freely, and to apply the sutures deliberately and efficiently, and to employ enemata, instead of medicine taken by the mouth. I consider that the administration of bark exercises a useful influence in promoting the union of wounds, whether in these parts or elsewhere.

CHAPTER XXIII.

EXTRACTION OF FOREIGN BODIES.—ACUPUNCTURE.

We are sometimes called upon to remove extraneous substances from among the tissues. Needles, or portions of them, are often accidentally driven through the skin into the subcutaneous cellular tissue, or deeper textures. They remain imbedded for a longer or shorter period, and sometimes for a considerable length of time, causing more or less of suffering, and, on the other hand, occasionally giving rise to no symptoms whatever. Needles, &c., whether introduced in this manner or through the stomach, (for portions of needles or pins are sometimes accidentally swallowed with the food,) travel about the body in a very remarkable manner, being often detected at very remote spots from that by which they were introduced. Persons occasionally present themselves, complaining of eccentric pains in certain parts, as the shoulder, breast, &c., which are found, upon examination, to be caused by the presence of some foreign body under the surface, or, being more deeply seated, the cause is not discoverable. They can give no account of the mode in which it came there, or perhaps they remember "breaking a needle in the finger" many months ago.

If we can extract the foreign body without difficulty, we should do so by making an incision over it. This spot is usually indicated by a little circumscribed thickening of the integuments. But we are often baffled in these trifling operations. Such attempts at extraction may appear very easy, we almost fancy we perceive the outline of the substance, but after dividing the skin and pursuing the examination for a considerable length of time, we are compelled to close the wound, having accomplished nothing. We should always hesitate to make an incision through the skin, unless we feel tolerably certain of effecting our object—failure is annoying both to the surgeon and the patient. Sometimes, in the case of a needle, by a little well-applied pressure, we may force the sharp extremity through the skin, and thus extract it without further inconvenience.

We are not often required, in civil practice, to extract shot or bullets from the body, but that duty may devolve on any surgeon. Having satisfied ourselves of the presence of a musket-ball, or other foreign body, in any recent case, or if its removal can be effected without increasing the danger, the attempt should be made. We ascertain its presence by means of a probe, or, what is far better, by the introduction of the finger, if possible: if it cannot be felt, we must seek for other less certain evidence, such as the existence of an aperture of entrance, and the absence of one of exit; but these signs are fallacious; more than one ball may have entered, or if only one, it may have split against the bone, one-half escaping, and forming a counter opening, and the other part remaining behind. All contrivances, in the shape of bullet-forceps, &c., for the purposes of extraction, are generally useless. If not within reach of ordinary forceps, the removal of any foreign body will be a matter of considerable difficulty. Bullets sometimes pursue a very remarkable course, being often turned from their original direction by an apparently trivial obstacle. Dr. Hennen observes, on this point, that foreign bodies take "routes not at all to be accounted for by any preconceived theories drawn from the doctrines of projectiles, nor to be explained by diagrams founded on mathematical rules." With regard to bullet-extractors and forceps, he says, "Unfortunately, we most require their mechanical power in tortuous passages, or deep, curved, and angular cavities, where we can least make use of them."* We may, if requisite, enlarge the wound. This, however, should never be done as a mere matter of course, without some clear and definite object. Dilatation of the orifice is generally necessary in order to facilitate extraction. When the foreign body lies tolerably near the surface, and at some distance from the original wound, (but not otherwise,) we may cut down upon it. We are justified, under these circumstances, in making a second wound. If a bullet be lodged in bone, it may be followed by means of saws, scoops, or trephines. Mr. Guthrie describes the consequences of a ball remaining imbedded in bone as generally very serious. Bullets, however, may remain encysted in various parts for many years, without causing any particular amount of inconvenience, and may at last require removal, as in the following case.

A man presented himself to me at St. Bartholomew's Hospital,

* Hennen on Military Surgery, 2d edition, pages 75, 76.

in the year 1845, and requested that I would remove his leg. He stated that he had received a musket-ball in the left knee, at the storming of Ghuznee, in India; that he had suffered pain in the joint ever since—a period of some four years; that he had no hope of recovery, as all means of relief had been exhausted. On examining his knee, I found a depression, about three inches above the outer condyle, formed by the ball, which had not passed through the limb. When this fact was fully ascertained, I felt much inclined to trephine the bone; but the question at once raised itself, at what point to trephine? Circumstances curiously combined to enlighten me in this inquiry. I had at that time under my care Captain H., the officer who led the storming-party at that siege, on the blowing up of the outer gates with gunpowder, and who was well informed of all the details. From him I learnt the height of the walls from which the soldier was shot, and the distance at which he must have been placed from their base; and by these means I calculated the angle at which he must have been struck, and that the ball, if not diverted from its course, must be deeply sunk in the substance of the inner condyle. This probability was increased by the fact of pain being referred to that region. Under these circumstances, I determined to trephine the bone. For this purpose I had a deep trephine made of about eight lines in diameter, and having drawn a line, forming an oblique circle around the joint from the point struck, I cut down on the condyle at the point crossed by this line. I then applied the trephine, and cut into the centre of the condyle. The bone was harder than it usually is in health, and of this sign I augured favorably. Having removed the centre, at the depth of somewhat less than an inch from the surface, I struck on a metallic body, which proved to be the bullet, and which I extracted with some little difficulty, by means of a strong instrument, on the principle of a cork-screw, which I had had made for that purpose. The man recovered, and retained a useful limb. Doubtless, the success of this operation was greatly due to good fortune and not exclusively to skill.

The above remarks are merely intended to illustrate the principles upon which such cases should be treated. For further detail, I must refer to the works of military surgeons, as those of Hennen and Guthrie.

ACUPUNCTURE.

The practice of puncturing the skin with a needle or fine lancet is sometimes adopted, with a view to permit the escape of serum from the cellular tissue beneath, in cases of anasarca. From six to twelve punctures are generally made in the lower extremity for this purpose, and the quantity of fluid which is removed by this means is sometimes very considerable—much more than might be anticipated. It is advisable not to make these punctures very near to each other. This operation has occasionally been followed by sloughing of the integuments, a result attributed to the too frequent introduction of the needle within certain limits. Hydrocele is sometimes treated in this manner; the fluid escapes into the cellular tissue of the scrotum, and from thence is rapidly absorbed. Acupuncture was formerly much practised for the cure of certain diseases, as neuralgia and rheumatism. It was sometimes combined with galvanism; two needles were introduced to a greater or less depth among the tissues, at a certain distance from each other, the diseased part being included between them, and a wire of the battery was attached to each. This plan of treatment is at present, I believe, very seldom resorted to.

We often assist our diagnosis of certain tumors by the introduction of a *grooved* needle into their substance. The character also of any fluid, the result of disease, may often be conveniently ascertained by the introduction of this instrument into the cavity containing it. A small quantity usually escapes along the groove, or, if the fluid be too thick or viscid to pass through the small aperture, we withdraw the needle, after rotating it, and generally find a sufficient quantity remaining in the groove for the purposes of diagnosis.

The introduction of a needle can scarcely be termed an operation. It is passed through the skin by a slight jerk, and carried onwards by gently rotating it. The resulting aperture seldom needs any subsequent attention.

It is sometimes preferable to employ a very small lancet, or the fine trocar, which latter is an instrument often of value in perforating the walls of cavities.

When we call to mind the uncertain nature of diseased fluid products formed within the body, which no tact, however erudite, can invariably determine, and recollect how entirely the treatment

by the surgeon, in many cases, should depend on an accurate diagnosis of the nature of such contents, no prudent man will be unprovided with some form of instrument of this kind, which will answer the useful purpose of exploring many diseases of doubtful character before proceeding to extirpation. Its introduction is productive of little pain, and I cannot say that I have ever known an example of injury sustained from its judicious use; while, on the other hand, its employment is occasionally the source of the greatest delight both to the patient and to the surgeon. Of the value of such instruments, whether in the form of a grooved needle or of a minute trocar, I will give one example that occurred in my own practice; ordinary examples are familiar to us all. Several years ago, I was consulted by a gentleman, formerly a member of our profession, who was enjoying in private life the reward of an active and honorable career of laborious devotion to his profession, during which he had deservedly acquired the esteem and affectionate regard of a large circle of his friends. He is yet well known in the county of Berks. This gentleman had a swelling of the cheek, which appeared to arise from the bone. The swelling involved the side of the face, was firm in substance, and rounded in form. It was not attended with much pain, and in size was equal to that of the section of about the half of a moderate sized orange. It had much the appearance of malignancy; in which direction the opinions of Mr. ——, of myself, and of another surgeon of eminence who was consulted, gradually pointed. The probable issue was well known to the subject of the disease; and as for myself, I would most willingly have relinquished any responsibility altogether. He had paid me several visits, and each visit rather tended to increase the fear of a malignant disease. After seeing him for some five or six times, I determined to bring the knowledge of its nature to a crisis, and we waited the issue of the inquiry in silent but most painful apprehension; and I need hardly say, that the moment that decided whether a man, with the high qualities I have described, should enjoy prolonged life, or be consigned to an early and most painful death, was, as it ever must be, a moment of intense interest. Pus, however, issued from the groove, and all anxiety ceased. Such moments are among the highest resources of the medical man, and afford him some reward for years of unrequited labor and anxiety of mind, that no money can purchase, and no reward can compensate. The above case proved to be an infiltration of matter in the masseter and neighboring muscles.

CHAPTER XXIV.

ON THE CÆSAREAN OPERATION AND OVARIOTOMY.

CASES REQUIRING THE CÆSAREAN OPERATION. — THE MORAL LAW OF ENGLAND DEMANDS THE PRESERVATION OF THE MOTHER.—CASES FOR EMBRYOTOMY. — OPERATION BEFORE THE FULL TERM OF GESTATION CONSIDERED. —OPERATION BEFORE LABOR HAS BEGUN.—TEMPERATURE OF ROOM.—CHLOROFORM.—OPERATION.—AFTER TREATMENT.—OVARIOTOMY.—NATURE OF DISEASE. — DIAGNOSIS IMPORTANT.—UNILOCULAR CYSTS.—MULTILOCULAR CYSTS.—VARYING CONTENTS.—INDICATIONS FOR OPERATING.—CONTRA-INDICATIONS.—OPERATION.—AFTER TREATMENT.

THE name of this operation indicates its antiquity. But, notwithstanding its antiquity, it is an operation so rarely undertaken, that few surgeons, indeed, can be said to be possessed of experience in its performance. The Cæsarean operation is resorted to in cases of labor, in which the transmission of the child, in any condition, through the lower aperture of the pelvis, is rendered impracticable, by reason of the contracted nature of the aperture. The completion of the labor must not be simply difficult, but impossible. All the resources of modern art, and all the improvements of manipulative skill, must be proved incompetent to extract the fœtus, even though reduced to fragments within the cavity of the uterus. But this reduction is itself impracticable. Hours, and even days, of actual labor elapse, and no advance is made in the descent of the fœtus. The bones present an impassable barrier to the advance of the function, and the mother dies exhausted, or the uterus bursts in the repeated efforts to expel its contents.

This condition of the pelvis may exist in early life, and be coupled with general rachitis of the osseous system, or may supervene on some change in the health of the woman in after-life, and limited to the pelvis only. It is not uncommon, in the records of such cases, for a woman to bear a child, which is expelled without difficulty, and within two or three years to undergo such alteration

in the form of the pelvis as precludes the possibility of natural birth. This morbid condition consists in the contraction in the natural dimensions of the antero-posterior diameter, and is caused not by the approximation of the coccyx to the arch of the pubis, but by the descent of the sacrum towards the symphysis. The approximation is so great as to preclude the free introduction of more than one or two fingers into the vagina. The finger comes into almost immediate contact with the promontory of the sacrum, and the antero-posterior diameter is reduced to a length of from one to two inches, while that of the transverse may remain unaltered.

The first and most important consideration relates to the possibility of extracting the fœtus piecemeal, by the operation of embryotomy, for the life of the mother is our first consideration. Such is the moral law that guides our British practice. Not so imperative, however, is this law on the continent; nor, indeed, was it in the earlier period of our own country, and hence the more frequent recurrence to the Cæsarean operation in foreign countries. This, however, is the just and prevailing law of England, in which we have recourse to this large and dangerous operation so rarely; and such, perhaps, is the explanation of the fatality that attends it, inasmuch as the disinclination to resort to its agency may explain its unnecessary postponement, until the strength of the patient is too far exhausted to sustain the operation without additional danger.

In the Statistical Records, by Dr. Kayser, of Copenhagen, the Cæsarean section had been performed, up to the year 1839, no less than three hundred and thirty-eight times since the year 1750; of which cases one hundred and twenty-eight recovered.* Many examples are recorded of recovery from the operation repeated on the same woman. Dr. Michaelis, of Kiel, operated three times successfully on the same subject. An example is also related of success attending its performance four times on the same woman.† When we hear, however, as in the statement of Dr. Hœbeke, that the operation has been performed no less than fifteen times by the same operator, we may reasonably inquire, whether all the resources of modern art were exhausted before having recourse to the section of the uterus. With respect to the facility of removing the fœtus by means of the operation of embryotomy, there is no doubt that it is

* British and Foreign Review, vol. xiv.

† Edinburgh Med. and Surgical Journal, vol. xlvii.

possessed in different degrees of perfection by different accoucheurs; for success does not more depend on manipulative skill than upon the exercise of patience, and the endurance of both fatigue and trouble by the accoucheur, as well as of suffering by the patient. The difficulty of obtaining a free access to the uterus for this purpose may, independently of the contracted state of the pelvis, derive increased difficulty from the condition of the cervix.

In a case I shall afterwards relate, of deformity occurring in early life, in which the cervix was jammed in between the bones, the lower part of the organ did not participate in the general actions of the remainder, but continued flabby and undilated up to the moment of the operation. This fact, supposing it a general one, should be kept in mind, as likely to distinguish the cases of contraction from congenital deformity, from such as had occurred in later life, and especially from cases requiring the operation on women who had previously produced one or more children by natural birth. In such cases I imagine that the operation by embryotomy would be impracticable, unless by division of the cervix uteri, which would render the undertaking so complicated as to influence strongly the decision in favor of the larger operation.

It is obvious that no absolute rule can be laid down applicable to all cases of questionable necessity. It is equally so, that an antero-posterior diameter of one inch is incompatible either with the descent of a full-grown fœtus, or with the manipulation required by the embryotomist. Therefore, in such a case, we resort at once to the Cæsarean operation; while, on the other hand, supposing the diameter to be that of two inches, its necessity then becomes a question. In my first operation, performed in 1847, this diameter by admeasurement after death, on removing all the soft parts, was one inch and one third, and when we occupy a portion of this space by the uterus, with its double wall, the bladder, and the cellular membrane, I may give the real breadth as not more than one inch. And yet in this case there were not wanting in the examination authorities, if such they may be called, who deemed the operation for embryotomy all that was required. This is human nature, and quite unalterable.

In reference to the operation of embryotomy, we must recollect that we are engaged in the endeavor to extract the fœtus from an organized, though by no means a highly sensitive cavity. Under many conditions of eccentric birth, the uterus is the subject of very

rough and often of violent handling, of which inflammation of a serious character is no infrequent result. But how much greater violence is sustained by this organ in cases of protracted embryotomy, in which large and ponderous instruments are introduced again and again, through a period of many hours' duration, during which, although there may be no escape of blood, the nervous system of the patient is tried to the utmost verge of human endurance. Yet it cannot be denied that this painful operation is preferable to the alternative of the division of the uterus. Such, however, are the responsibilities of the case, that few medical men would undertake them without the conviction of their absolute necessity, and in cases admitting of doubt, every available authority should be consulted.

With regard to the question of time, the earlier its performance the better, after labor has actually commenced. No doubt, the fatal result in many cases may be attributed to the exhausted condition of the patient before the operation was resorted to. Days and nights have elapsed during which the indecision of the surgeon has failed to appeal to the only resource admissible, and the patient has either sunk immediately under the loss of blood, or life has been prolonged for a few hours only.

When the condition of the pelvis is ascertained at an early period of gestation, a question may arise as to the expediency of the attempt to forestall the usual date of delivery by an early operation. Such a question was raised on my first case, of which the following are some of the particulars, extracted from notes taken at the time.

On the 25th of November, 1846, Mr. Jolin placed under my charge the case of Sarah Bartlett, aged thirty-two, four feet one inch in height. She was a member of a tall family, but had ceased to grow from seven years of age. She was in the seventh month of pregnancy. Mr. J. informed me that he had examined her *per vaginam*, and had ascertained the impossibility of her producing, *per vias naturales*, a child even at that period. This opinion having been confirmed by other authorities, I took her into the hospital, and by the kindness of the Treasurer a private room was awarded to her. Shortly after her arrival, she was examined by my friends, Dr. Rigby and Dr. Smith, in conjunction with Mr. Jolin, himself no weak authority in obstetric matters. These gentlemen ascertained, that the antero-posterior diameter was not more than about an inch and a half; that embryotomy was impracticable, owing to the contracted size o

the superior inlet to the pelvis, and the proximity of the promontory of the sacrum to the os pubis. I also ascertained the same facts by examination. The patient being placed under my charge, the first idea that struck me was the desirableness of getting rid of the evil as early as possible. The grounds on which I reasoned were these: at the present period, viz., at seven months, the fœtus is small, and the uterus equally so, in proportion. The vessels will bleed less freely, being of smaller calibre. The external wound will be large only in proportion to that required by the uterus. The operation is thus simplified, and has but two objections, viz., that the fœtus of seven months will probably not survive so sudden and unceremonious an introduction into life; and, second, that the woman herself, being at present free from all inconvenience, the operation will come under the class of "operations of expediency." But the woman was unmarried, and had no desire that her child should survive, her own reputation being to herself an object of higher consideration than the life of the child. Having no inclination, however, to become a participator in this sentiment, that argument weighed but lightly on my mind. Yet, in reflecting on the matter, I confess I was inclined to waive all consideration for the child, and to keep my anxieties exclusively for the benefit of the mother.

However, all my reasoning was subverted by the opinions of others. On this question I consulted Dr. Locock, Dr. Ferguson, Dr. Rigby, and other eminent accoucheurs, and I also had the opinion of several hospital surgeons. The surgeons, like myself, were generally in favor of the early operation; the accoucheurs of the latter one. The grounds on which the latter formed their opinion were these: Nine months was the natural period of gestation, and at the full term the constitution underwent an important change on reaching a natural crisis; that it would enhance the danger to her life to throw a violent obstacle in the way during the progress of gestation, at that late period of it; that miscarriages, even without violence, were often more dangerous to life than confinements, owing to the above cause; that among the causes of failure hemorrhage was comparatively a rare one; and, finally, that there would probably be no considerable addition to the quantity of blood lost by an operation at the ninth month beyond that at the seventh.

The unanimity of this opinion, with the exception, perhaps, of Dr. Locock, compelled me to waive my own opinion, though I could not but view, with something allied to alarm, the meandering veins

of enormous size, some of which, nearly half an inch in diameter, crossed the uterus, as exhibited in the injected preparation in the hospital museum. Still I felt that the case was a compound one, involving the best resources both of the accoucheur and of the surgeon; that in all matters relating to the science of the accoucheur, I was bound to be influenced by his experience and his reasoning, so far as it was brought home to my own convictions, while, in the purely surgical department of the case, I early determined to follow the dictates of the best judgment I could myself bring to the case. So far as relates to the matter of experience, however, there was, in fact, none to be had. The position is an unrecorded one; at least I could not ascertain, in any record of midwifery practice, the existence of a case in which these questions had been raised. I place, therefore, before the reader the grounds on which I acted in determining to postpone the operation till the full period of the ninth month.

A second important question then presented itself for consideration, viz., whether, on waiting for the full term of gestation, I should operate after labor had actually commenced, or select a convenient hour before labor pains were positively established. The advantages of the latter course were great. I could select the hour, and could not be taken by surprise; the patient could be prepared for the effort up to the hour of the operation; I should be able to command any assistance, and such requisite attendance as might confer important advantages on my patient. The other alternative was not, however, to be readily disposed of. To what end had I been waiting during two months, and superseding the advantages of an early operation, but that the constitution should be freed from a sudden shock? There could be little alteration in the woman's condition in the course of the two months, unless labor pains had actually begun; unless her constitutional powers were screwed up by necessity for some great effort, of which the operation would form a part. In referring to the cases recorded, I find the operation rarely, if ever, to have been done before labor had commenced. My own impressions, therefore, were confirmed on reflection, that it would prove a less severe shock to her constitution, if I waited till labor pains had begun, and then operated before her strength was impaired by the exhaustion consequent on their long continuance. The statistics of the Cæsarean operation compel us to refer the frequency of death to protracted labor, when the uterus had been struggling against a

mechanical obstruction during sixty, seventy, or eighty hours, under which circumstances death occurs in the relation of 75 per cent.; and it is an equally important feature in this calculation, that the results of early operations were as favorable in their issue to both mother and child, as the late cases proved fatal to both, the death of the child being, in the latter, almost certain. By the term early operation, is understood cases in which the uterus had been relieved within twenty or twenty-four hours; but within this period the earlier the operation be undertaken the better.

Two subjects for consideration yet present themselves before I proceed to the operation itself: the first relates to the question of temperature; the second, to the administration of chloroform. With regard to the first of these, it is urged by some authors, among whom is Dr. Frederick Bird, that the temperature of the room should be raised, as nearly as may be, towards blood heat. His recommendation relates, however, to operations for the excision of ovarian tumors, and not to the section of the uterus. There is an important difference between the two. In the operation for ovariotomy, the draught on the vital powers is not great, the operation itself is far less serious, and little if any blood is lost; but in large operations, involving serious loss of blood, such elevation of the temperature of the room is always injurious, by its depressing influence on the nervous system, and is in my opinion to be avoided. The temperature is unnatural, and the respiration is hampered by its intensity. If we avoid cold, and study comfort, it is all that is required. A cool temperature is more congenial to the action of the lungs, under almost all circumstances, than a hot one, and in my opinion, far less likely to provoke evil consequences, whether catarrhal or inflammatory.

With respect to the administration of chloroform, I am not prepared to give a very positive answer. In the second operation I performed, Dr. West, accustomed to witness the beneficial effects of this agent in St. Bartholomew's Hospital, entertained strong objections to its administration: but I am not certain with quite sufficient reason. That chloroform prostrates the powers in a slight degree, I fully believe, but in a slight degree only, and it must be acknowledged that the Cæsarean operation cannot be classed among the most painful operations of the surgeon. On the whole, however, I am disposed to recommend its use in moderation. With a view to prepare for every contingency, it is a part of the duty of the ope-

rator to ascertain, if possible, the position of the placenta. At all events, negatively, that it does not lie over the line of incision into the uterus, and this knowledge is generally to be acquired by careful auscultation. If it appear to be connected to the anterior wall of the uterus, we are prepared for a difficulty, which, presenting itself unexpectedly in the course of the operation, would cause hesitation and possibly alarm.

The above being the conditions in which the attempt to relieve the uterus of its contents should be resorted to, I proceed to the description of the operation. The incision should be made in the linea alba. The lateral position of the uterus in the abdomen is no excuse for an incision in the linea semilunaris, and the transverse section, without sufficient reason, appears preposterous. It would tax my ingenuity to discover an adequate motive for this form of incision. Its length should depend on the size of the uterus and of the abdomen. Probably from six to ten inches would include the extremes. A part of this line must necessarily be above the umbilicus. Before making it, the outline should be marked in ink, otherwise we have no certain guide to the centre of the abdomen.

In the act of making the first incision, and until it is completed, it would be well to request the assistants, of which four in number at least are required, to support the sides of the abdomen gently, with a view to press the uterus against the abdominal walls, for the purpose of excluding the small intestines. The incision should stop short of the pubes by about an inch or two. Two assistants should follow the line made by the knife, with their hands compressing the abdominal parietes against the uterus, to prevent the escape of intestine from the wound. Much of the success of the operation depends on this manipulation, for the escape of intestine not only retards the proceeding very unprofitably, but the requisite efforts made to restore and to retain the intestine within the abdomen are necessarily injurious, as being liable to provoke inflammation. When the abdominal section is completed, the operator should take a rapid glance at the position of the uterus. The organ will probably lie over to one or the other side, and the extent of this deviation from the straight line should be ascertained by passing the hand into the abdomen as far as the side of the organ. If its obliquity be great, the uterus should be raised a little and supported by the assistant, because it is of great moment that the incision into it be made in as straight a direction through the anterior wall as possible. If the

uterus lie very obliquely, an upper angle may present at the outer wound, and the consequence may be that the Fallopian tube will be involved, and liable to division. With respect to the question of hemorrhage, and to the necessary contraction of the organ on the removal of its contents, the longitudinal incision is most eligible.

The section of the uterus may be made almost immediately, for the quantity of blood that flows from the outer wall is always slight, if the incision have been correctly made in the linea alba. The section of the exposed organ should be effected by a long superficial incision, gradually deepened and completed by a deep grooved director, armed with a large but pointed knob; the length of the incision, varying from five to seven, or even nine inches, but dependent on the size of the organ. When the contents are fully exposed, the membranes should be ruptured by the hand, some part of the child will immediately present itself at the wound; the hand, then grasping the entire fœtus, removes it to a length sufficient to tie the cord. The bleeding at this moment is considerable enough, and often immense, and the patient sinks rapidly towards a state of deliquium. The hand is now again introduced into the uterus, for the purpose of removing the placenta, which is to be quickly, but gently detached. If this structure occupy the anterior wall of the uterus, there remains no alternative but cutting through and detaching it as rapidly as possible, and even should this relation be ascertained before the operation is commenced, it would not justify any variety in the incision through the walls of the uterus. On removing the child, the uterus sinks, and the abdominal parietes hold a new relation to the contents. Tension is changed to flaccidity, blood flows copiously from the uterine walls, the atony of the muscles offers a very inefficient resistance to the escape of intestine, the prevention of which demands the greatest care, otherwise its descent is inevitable. Two pairs of hands, at least, are requisite for this purpose, and the best management will be required. The uterus rapidly contracts, and the hemorrhage is reduced in amount during every subsequent minute. As the contraction approaches the natural dimensions of the organ, the tendency of the intestine to escape is also diminished, and some ten or twenty minutes may be allowed to elapse for the entire cessation of the bleeding, and the restoration of the uterus to its natural size after delivery. I found great benefit to be derived from a circular bandage of about nine or ten inches in breadth, divided across the middle, and the cut edges connected by about a

dozen strong silk threads, of eight or ten inches in length. This bandage is passed around the body of the patient before the operation is commenced, and on the contraction of the uterus and the cessation of the hemorrhage, it is to be drawn down over the abdomen, and held lightly by two assistants. It will be found to form an excellent temporary substitute for closure of the abdominal wound, while it permits free manipulation between the threads, in the passing of sutures. The operator should give ample time for the uterus to contract. If blood continues to flow, it is much better that the escape be visible than that it flow into the abdomen, after the wound is closed.

Two other considerations yet require notice:—first, the indispensability of ascertaining that no portion of intestine is involved in the uterine wound which has occasionally caused fatal strangulation; and, secondly, the patency of the os uteri should be ascertained by the introduction of the finger into the cervix. The wound may now be united by sutures passed through the substance of the abdominal parietes, but not including the rectus muscle, if exposed. Perhaps ten or twelve may be employed. The last inch above the pubes may be left ununited, in order to permit the escape of blood, or lochial discharge. Strips of sticking-plaster should be applied over the sutures, and a moderate compress of cotton-wool will complete the operation.

The Cæsarean operation should be rapidly and boldly executed. Every appliance that contingencies may require should be readily at hand, including a warm-bath for the child, and other material of the nursery. Neither the linea alba nor the uterus is highly sensitive, and may be divided freely. In my first operation, the child was in the arms of the nurse in five minutes and a half from the time of the first incision. In the second, in six minutes and a half; but safety requires that the subsequent stages of the operation be executed with care and deliberation.

The after-treatment of the Cæsarean operation consists in allaying suffering, in upholding the vital powers, and in fostering the recurrence of the natural functions of the body. The first indication is upheld by ease of position, and by the agency of such sedative medicines as will tend to "steep the senses in forgetfulness," without impairing the internal functions of the body. I plead guilty to the error of excessive pressure on the abdomen in my first case, and I was so far myself unmindful of one important indication. The

patient survived about thirty-six hours. In the second case, in conjunction with my friend Dr. West, and other eminent physicians, my patient was treated with opium in rather large doses, both by the stomach and by enema; and so far successfully. The young woman was constitutionally irritable, with a standard pulse of one hundred and twenty, and had been previously insane. The patient survived to the sixth day, and then sank. Both infants survived.

The loss of blood incidental to the division of such large vessels compels the early resort to food as the best protective against inflammation. The secretory functions of the body generally, especially those of the skin and kidneys, should be encouraged, but the intestines should be kept in a state of perfect quietude for several days. An occasional injection is all that is required. Local pains should be treated with opium, and not by depletion.

ON OVARIOTOMY.

This large and serious operation is resorted to for the purpose of effecting a permanent cure in cases of ovarian dropsy. The proposition of the removal, by section of the abdominal parietes, of the secreting cyst of an ovary, is not a recent one; but the execution has, within the last ten years, been attended with results that set at rest the early anticipations of danger, which emanated from many of the most experienced members of our profession. Abundant evidence is obtainable, justifying the resort to it as the radical means of removing a disease, the records of which have ever testified to its fatality, provided the cases be selected with skill and experience. Unhappily, the operation of ovariotomy is not applicable in all cases of ovarian cysts, nor, perhaps, in the majority of examples, unless we are permitted to enlarge the circle by the admission of cases in which the danger increases, and in which ultimate recovery is more than questionable.

With respect to the nature and origin of the disease, it is well known that the ovaries of the human subject are liable to the formation of cystic cavities, either singly or in numbers, occasionally clustered together like a bunch of grapes. Sometimes cysts form within cysts, and each presenting different characters, both as regards the material of the cyst and the nature of the contents. Some may be lined with a vascular membrane, and the exterior is often sub-cartilaginous in texture. One or several of such cysts may

enlarge at any period of life after puberty, till they reach an enormous magnitude, distending the cavity of the abdomen, restricting the powers of respiration, by compression on the diaphragm, and impairing the function of digestion. The texture of cysts thus formed varies materially in thickness, exhibiting sometimes the tenuity of a thin membrane, and occasionally acquiring the thickness and substance of a fleshy texture. As great a variety pervades the contents, which, though generally serous and limpid, assume the varieties of albumen, lymph, puriform, and purulent fluid; indeed, when the cysts are bilocular, or multilocular, the contents of one or more of these tumors may vary in character from the rest. The resort to some agency more efficient than the temporary benefit derived from the ordinary operation of puncture has been rendered necessary by the almost universal fatality that attends the disease, when subjected to the ordinary treatment of tapping. Of such cases it is rare that the patient survives the disease for a longer period than two years, and the majority die within twelve months. When, therefore, we consider the frequency and the fatal character of ovarian dropsy, it is not surprising that patients are found who will willingly submit to, and surgeons who will undertake an operation, which, though not unattended with danger to life, yet offers the only alternative to almost certain death by the substitution of means that will, if successful, terminate in their entire recovery. A most correct diagnosis of every case is indispensable to success, without which all is uncertain and unsafe. Indeed, we cannot form any approach to correct statistics of the operation, without the most accurate diagnosis; and the only mode by which we can legitimately reduce the extent of danger to its most moderate limits is to resort to the radical cure only in such examples of the disease as offer a prospect of the greatest success, and to restrict the operation to cases composed of cysts, containing serum, or slightly albuminous. Unless the diagnosis be most accurately made, we are in ignorance both of the number and the nature of the cysts, which on exposure may prove to be so large and so solid as to be unmanageable by the operator, by resisting evacuation by the largest canula passed into them. If diagnosis cannot decide on these matters, both as regards number and quality, the operation should demand yet further deliberation. If these conditions can be ascertained, and prove favorable to the experiment, there is no medical reason why the operation should not be undertaken.

The history of the case, founded on the report of past symptoms, has no concern with the number of the cysts; the fact can only be ascertained by careful, and often by elaborate, manipulation; but with respect to the character of the contents, a question of perhaps equal importance, history is intimately concerned. In the watery cyst, the past symptoms are almost exclusively confined to such as are consequent on mechanical distension, and without pain or other concomitant, and may be of comparatively rapid growth; whereas, the solid contents indicate a more chronic progress, each form, however, being unaccompanied by local pain, except from the above cause. The puriform, and still more the purulent, contents, are the consequence of local action, which has long been the accompaniment of pain, and general derangement of health. Such are the occasional conditions consequent on the puncture by the trocar; inflammation follows the operation, and the new secretion becomes purulent instead of serous. Besides, the question of the nature and contents of the cysts is another, of no less moment, perhaps of yet greater importance, as regards the eligibility of the operation, than either of the above, viz., the adherent or non-adherent relation of the cyst to the structures around, for it is obvious that, however suitable may be the proposed operation, so far as relates to the structure of the sac and the nature of the contents, if the mass be adherent to any considerable extent, an operation is inadmissible. The cases selected, therefore, in which it may be most favorably resorted to, are such as have not been tampered with by frequent evacuation, or by the attempted cure by pressure, and have been free from all signs of inflammatory action, in which, as above described, the disease has travelled onwards without pain or serious illness, or the presence of any other sign beyond that of mechanical pressure, and the numerous lesser ailments arising from it. The case is, therefore, rendered less eligible, in which tapping has been even once resorted to; because it argues the greater probability of adhesions, and the liability to altered secretion, and unless the negative of these conditions be ascertained on examination, the operation becomes doubtful.

The knowledge to be acquired by examination demands both tact and delicacy. The first question to be determined relates to the simple or multilocular character of the mass, inseparably connected with which, however, is the nature of the contents. We must ascertain to what extent the impulse caused by tapping with the

finger is felt over the abdomen. We should take any given point, and proceeding thence, in all directions, obtain this information; for the impulse, being conveyed with much greater facility through the medium of the fluid contents, than of the cyst itself, if obtained by a light and delicate manipulation, may be detected with great precision. The same action should then be repeated in the line of every transverse diameter, and supposing the impulse across to be perfect in all directions, we may deduce the fact of the absence of any large secondary cysts. In cases of large bilocular cysts, placed side by side, and occupying the general cavity of the abdomen, the impulse conveyed, by concussion, from right to left, is different from that from left to right; this difference depending on the concussion of a large mass of fluid passing through a small one, and vice-versâ. This inquiry will be made with facility proportioned to the fluidity of the contents, as I have remarked in the earlier part of this work. According to the fluidity, and to the purely serous nature of the contents, will exist this facility of transmitting the impulse from side to side: and, indeed, it is worthy of remark how slight a concussion by the finger is conveyed across the tumor when an aqueous fluid is contained in a single cyst. These are niceties that may be acquired by practice, but which are perfected only in men of refined sensations. These two questions being determined, the third, which relates to adhesion, can only be approached within the circle of probability. We test it by its general mobility; and, negatively, by the absence of local pain or former disease throughout the growth; and the probability of the absence of adhesion is further strengthened by the unilocular character of the cyst, which fact has already been ascertained. If the two former conditions have been established—if the impulse be conveyed across, responding to the slightest concussion of the finger, and not arrested in its course, requiring a new starting-point to reach the opposite side, and there remain no evidence of adhesion obtained from mechanical examination and former history, and the patient's health be otherwise good, the case presents no indications precluding the resort to the operation.

The patient is placed in a semi-reclining position in bed, leaning against a firm support, covered with pillows. The temperature of the room having engaged the attention of the profession, I would add one word on this subject. It is the practice of Dr. Frederick Bird, who performs this operation with great skill and dexterity, as I can

myself bear witness, and has obtained the concurrence of others, to raise the temperature to a degree beyond that which is in my opinion very supportable either to the patient or the attendants; which temperature is retained so long as inflammation is impending. I quite concur with Dr. Bird, in the principle of averting inflammation by diaphoresis, and in the chapter on Aneurism I have given an example of my adhesion to this doctrine as far back as the year 1842; but I strongly object to the admission of any depressing agency during an operation, which in my opinion can only increase an evil already great. Elevate the temperature, if you please, during the time at which inflammation may be anticipated, but not during the operation, for inflammation cannot appear for many hours afterwards; and I conceive, that the resort to this depressing agent should not be made until the shock of the operation has entirely passed.

The incision, which is to be made with a strong scalpel, should occupy the mesial line of the linea alba. Its extent should be as short as possible. From four to five inches will suffice for the removal of any cyst, for which an operation is admissible. Less than this length will increase the difficulty of manipulation, supposing the disease to prove multilocular, and the contents very albuminous or fibrinous in character. With respect to the question of chloroform, I both adopt and recommend the resort to it; except indeed the opinion of the operator be pledged to the elevated temperature of the room, when it is, I conceive, contra-indicated by the tendency to faint.

The incision need not be carried above the umbilicus, nor quite down to the os pubis. The division should be made with some care through the fat and peritoneum, till the anterior surface of the sac is exposed. This membrane should then be seized with a strong pair of hooked forceps, with pointed and projecting teeth; by means of which the sac should be firmly held. As the fluid flows off, both the cyst and the prominent abdomen become reduced in size, and the former, gradually elongating, is drawn without effort through the wound. A second cyst may be brought into view, seized and punctured as before, and the entire cavity or cavities evacuated. By this process, the cyst will collapse with the loss of their contents, and, unless adherent, will escape from the wound up to their root. If adhesions present, and are susceptible of separation, the practice is obvious; if not, the contents of the cavity should be evacuated,

and the cyst cut at a slight distance from the adhesion. Little or no blood will have escaped, and, generally speaking, the intestines remain passive, and are often not even visible during the operation. The neck or root of the cyst is to be surrounded by a strong and well waxed cord of silk, which is drawn tight around it, and the end, with that of the divided cyst, left hanging through the wound. All that now remains is to apply several sutures to the wound, the edges of which should be brought into perfect apposition, to invest the abdomen with a layer of fine cotton wool, and to apply moderately firm pressure, by means of a flannel roller. The patient, when placed in bed, should be laid on her back, with the legs raised over a pillow sufficiently high to relax the abdominal muscles. For the after treatment, I must refer the reader to the subject of the Cæsarean operation, and elsewhere, warning him against unnecessary depletion, by the agency of the lancet. The treatment of Dr. Bird is, I think, to be followed in principle, if not entirely in detail. The advantage of the administration of ice, in conjunction with diaphoresis, is very positive.

ON THE ADMISSION OF AIR INTO VEINS.

A few words on this interesting subject.—Many examples of this terrible accident have been recorded, and I know of no circumstance which might occur during an operation, more calculated to create alarm in the minds of all persons present. The great and sudden change, from life to apparent death, in many instances the obscurity of the cause, and therefore the doubt which must necessarily arise as to the efficacy of the means we should employ to restore the vitality of the patient, all conspire to confuse and embarrass the mind of the operator.

This accident has generally occurred during operations about the base of the neck or thorax, at some spot near the termination of the large veins in the heart, a fact not difficult of explanation, when we bear in mind the influence exerted by inspiration upon the return of venous blood to the heart. The circumstances attending the entrance of air into a vein are generally the following. The surgeon may be engaged in dissecting out some form of tumor from the base of the neck or axilla, and during the operation he renders tense the parts to be divided, in order to facilitate the action of the knife. At the moment of division, the patient inspires, perhaps deeply,

by no means an uncommon occurrence during an operation, a hissing or gurgling sound is for a moment heard, or perhaps no sound may be audible, and the patient suddenly falls into a state of collapse, the powers of the circulation rapidly fail, the pulse ceases to be distinguishable, the respiratory movements are incomplete and irregular, a deadly pallor overspreads the countenance, the corneæ appear more or less hazy, and the irides become indifferent to the influence of light, the temperature rapidly falls, and a cold sweat partially bedews the surface; in short, all the symptoms of approaching dissolution by syncope are present, and in a few minutes the patient ceases to live. In some instances, the symptoms are rather allied to those of apnœa, combined occasionally with those of coma; the pulse, although still to be felt, being slow, and irregular, with ineffectual and spasmodic attempts at respiration, and the countenance becomes livid. Should the patient be happily rescued from death, more or less severe symptoms of febrile excitement gradually supervene.

The post-mortem appearances which have been generally observed, are, briefly, great venous congestion, the right side of the heart more or less distended with blood, rendered frothy by the presence of air, of which a quantity is also usually found in the pulmonary artery, and more rarely in the vena cava superior, the left side of the heart contracted, containing little blood, and very rarely any air; the lungs appear healthy. I shall not venture to enter at length into any discussion concerning the proximate cause of death. Blood, rendered frothy by the presence of air, is incapable of passing through the minute capillaries of the lungs, and the evidence before us points to this fact as the chief one concerned in the production of death. How far the presence of air in the cavities of the heart may be primarily concerned in the annihilation of its movements, is not yet determined, but I am rather inclined to regard its impaired action as produced secondarily by disorder of the pulmonary circulation. The question has been discussed at considerable length, and numerous experiments performed, with a view to elucidate the phenomena observed. The subject has been ėspecially investigated by Bichat, Rysten, Amussat, Sir C. Bell, Cormack, Dr. J. Reid, and more recently, by Mr. Erichsen.

In all operations where this accident is liable to occur, we should employ every care to guard against its occurrence. We should hesitate to divide parts in a state of tension, where there is any proba-

bility of wounding a large vein, and more especially at the instant of inspiration, and it would be well, whenever a doubt may arise, to exert pressure between the parts to be divided and the heart. Should this accident unfortunately occur, our remedies, to be effectual, must be promptly applied; there is no time to consult or consider, and barely sufficient to act. The first indication, of course, is to check the further entrance of air by pressure over the orifice. Should the symptoms be those of syncope, the patient, if not already reclined, should be placed horizontally, with the head lowered, and the application of warmth, friction, and stimulants made. Above all, artificial respiration should be most perseveringly employed. If the symptoms of asphyxia predominate, the abstraction of a small quantity of blood from the external jugular vein may in some cases be beneficial.

CHAPTER XXV.

OPERATIONS ON THE EYE.

PRELIMINARY REMARKS.—WOUNDS OF THE EYELIDS, &c.—SUPPURATION.—ECCHYMOSIS.—TUMORS.—GREAT VARIETIES OF ENTROPION.—ECTROPION.—LAGOPHTHALMOS.—PTOSIS.—ANCYLOBLEPHARON.—SYMBLEPHARON.—EPICANTHUS.—TRICHIASIS.—DISTRICHIASIS.—CANCEROUS DISEASE OF THE SKIN.

It is unnecessary to dwell upon the importance of this branch of operative surgery. "Every one feels that sight is the most valuable of the senses; that it not only is in itself the most important inlet of knowledge, the most valuable medium of our communication with surrounding persons and objects, but also that it is essential to the full enjoyment of our other senses; to the free exercise of almost all our other faculties and endowments; so that these lose more than half their value when sight is gone."* Even the resources of a mind like Milton's seemed scarcely sufficient to alleviate his loss; and the unequalled description he gives of his affliction affords the best evidence of the value of this organ.

In no other part of the body does the success of an operation so much depend upon the excellence of its performance as the region of the eye. Errors, which are comparatively of little moment when made elsewhere, often prove fatal to the success of these operations; and, indeed, it is a peculiarity of this branch of the subject, that there is no stage or degree between complete success and total failure. The remarks formerly made on the qualities demanded by the operating surgeon now apply with increased force. Above all, is a practical acquaintance with the subject necessary, for experience is here bought at its highest price. Extensive practice on the dead subject, or on the eyes of animals, should precede any attempt upon the living; for errors rarely admit of being rectified, and the hope

* Lawrence, on Diseases of the Eye, p. 1, second edition.

of "doing better" in the next case affords but indifferent consolation to ourselves, and none whatever to our patient, for present failure.

Operations on the eye, although subject to general principles, are still peculiar in their nature, and demand of the surgeon a special experience. I shall offer no remarks on the anatomy of the eye, because a minute knowledge is absolutely necessary; and any superficial description would, I conceive, be worse than useless.

Most of the instruments used in operations on the eyeball are more or less peculiar in their construction, and a thorough examination of them will be of more avail than the most lengthened description or the most accurate plates. All instruments to be employed on the eye should be well made and perfectly finished. The surgeon should distrust the report of the instrument-maker for the efficiency of the cutting instruments, but should convince himself that they are in a condition to meet the necessities of the case. Imagine for a moment the vexation which would be caused by attempting to transfix the cornea with a blunt knife, and thus deranging the course of the operation, and the tranquillity of the patient.

All observations before made on the subject to be attentively considered, and the precautions to be employed in operations in general, apply more especially in those I am about to describe. The importance of the most perfect state of health we can command in our patient, of good and trustworthy assistants, of every variety of instrument which can be required, of a firm and perfect support for the patient, and, finally, of a good light, the indispensability of each and all cannot be overcharged. The use of chloroform is unnecessary, and inadmissible in almost all operations on the eyeball: unnecessary, because the pain inflicted is generally very inconsiderable; inadmissible, from the well-known effect of chloroform on the globe. Co-operation on the part of the patient is of no little moment; he should be impressed with the necessity of exercising all the firmness and self-command in his power, and all exciting and depressing influences should be equally avoided. We should make all such necessary preparation, that if the result terminate in failure, we shall, at least, be spared the reflection arising from the conviction that "we might have done better."

WOUNDS, ETC. OF THE EYELIDS.

General principles of treatment are applicable to wounds of the eyebrows and eyelids. Great care should be taken to adjust the edges with especial nicety; and for this purpose the finest sutures should be employed: it is very seldom that any form of adhesive plaster can be applied with effect. Wet lint should be laid on the part, and perfect quietude insisted on. During the healing progress of such wounds, great attention should be paid to the effect they have upon the eyelids, lest deformity result.

Suppuration, the result of erysipelas, is not uncommon in the cellular tissue of the eyelid, immediately beneath the integument. We evacuate it by a small puncture made transversely, so that the resulting cicatrix may be concealed by the natural folds of the skin.

Blows on the eye are often followed by *ecchymosis*, well known under the term "black eye." The effused blood is gradually absorbed, and, I believe, very little can be done to hasten the process: cold lotion is generally applied; a poultice, made of the root of the black briony, is a remedy of high repute, and perhaps justly so, among prize-fighters. When the effused blood is considerable in quantity and quite fluid, a small puncture of the eyelid, to allow its escape, will often prove advantageous.

TUMORS OF THE EYELIDS.

There are many of these tumors, some analogous to those met with in other regions, some peculiar to this.

Encysted tumors are by no means uncommon in the neighborhood of the eyelids, and often reach a considerable size. They should be removed by the knife, the external incision being always made, if possible, parallel to the fibres of the orbicularis muscle. A description of these tumors is sometimes found situated near the external angular process of the frontal bone, a superficial examination of which is very liable to lead to error: they appear to be loosely connected to the structures around, but are really very firmly attached to the periosteum, the bone being often indented beneath them. They are most frequently met with in infants, and are sometimes congenital.

In operating upon these tumors, the external incision should be

made of sufficient length to enable us, if possible, to remove them entire; it is desirable that no portion of the cyst remain behind. Mr. Tyrrel doubts the advantage of interference, as he has seen inflammation, sloughing, and exfoliation of the bone ensue. But this opinion is by no means a general one.

Another form of tumor consists of an imperfectly formed lobulated cyst, containing a small quantity of a milky fluid (*half encysted*, Lawrence; *glandiform*, Tyrrel; *albuminous*, Mackenzie). There is most generally a small point near the centre, through which part of the contents may be pressed out; sometimes there are more than one. The best mode of removing these tumors is to transfix them with a small knife, and gently draw out the divided halves with a pair of forceps.

Tumors are often found more or less connected with the tarsal cartilage, and are called "*tarsal tumors*." They are situated beneath the fibres of the orbicularis muscle, and very seldom reach a size beyond that of a pea. They vary in their nature, sometimes consisting of a "gelatiniform fibrinous matter, not encysted,"* but more generally encysted, containing a fluid, "sometimes limpid and clear, like serum, or frequently glairy and viscid, like the white of egg; occasionally semi-purulent, and in some few instances curdy:"† they occasionally inflame, and pus is formed. They often consist of diseased Meibomian glands. They project both externally and internally. The best mode of treating them is to evert the lid, puncture them from the inner side with a small double-edged knife, press out the contents, and *freely* break up the cyst, otherwise the disease will return. Should they prove solid, the soft texture may be broken down with a probe. In some cases, after this operation, a soft fungus projects, which, however, may be readily removed. It is an error to attempt the dissection of these tumors from the exterior of the lid, as they are so firmly attached to the tarsal cartilage that it would be necessary to cut into it, and thus, in all probability, make a hole completely through the lid. Mr. Tyrrel says, that "whilst the tumor is very small it should not be touched."

Tumors sometimes form immediately beneath the conjunctiva of the eyelids, where it is reflected on the globe; they most generally consist of a very thin cyst, containing a watery fluid (*hydatid*). They

* Wharton Jones. Ophthalmic Medicine and Surgery, page 450.

† Tyrrel on the Eye, vol. i. page 477.

are easily removed by incising the conjunctiva, and drawing them forward with a hook.

"*Hordeolum*, or *stye*, is a small circumscribed inflammatory tumor, situated near the free margin of the eyelid, usually about the size of a small barleycorn." It is, in fact, a minute boil or furuncle, the two diseases accurately corresponding in all their essential characters. The pain should be alleviated by fomentations or other soothing applications. The small tumor usually passes through its stages without requiring any other interference; sometimes, however, the minute slough which forms in the last stage separates slowly, and requires to be touched with nitrate of silver. I have, however, in several cases, transfixed the little tumor as soon as it was fully formed, with success, alleviating greatly the pain and materially hastening its progress.

Occasionally, instead of proceeding onwards to suppuration, it becomes indurated and torpid in its progress. It has been termed "*hordeolum induratum*." The terms *chalazion* and *grando* have been used in different senses by different writers on these subjects; by some employed synonymously to signify an indurated stye; others restrict the term grando to this tumor, and apply the term chalazion to the non-encysted form of tarsal tumor: this is of very little importance: the indurated stye rarely proves troublesome; seldom if ever requires removal; but generally disappears with improving health.

Minute encysted tumors, not larger than the head of a pin, are sometimes found along the margin of the lids, often scattered over the surface of the palpebræ and adjacent parts. They appear as minute white points, are rarely found singly and are termed *milia*. They remain stationary and cause but little inconvenience. Perhaps the best mode of removing them is to scratch the epidermis covering them, and then press them out. Some practitioners excise them with scissors, previously making a small incision on either side, if they are deeply imbedded.

Small watery vesicles also appear along the margin of the eyelids, and are termed *phlyctenulæ*. If simply punctured, they soon re-form. They should either be removed with the knife, or with scissors; or a portion may be removed, and the remainder touched with nitrate of silver.

Verrucæ, or warts, occasionally grow on the eyelid; if pedunculated, they may be removed, and an escharotic applied to the bleed-

ing surface. If they have a broad base, then the escharotic alone will suffice.

Nævi are sometimes found in this locality, both the simple mole and the vascular nævus; the subcutaneous form is, however, rarely seen here. They are discovered soon after birth. The mole is a simple discoloration of the integument, and is productive of no evil beyond that of being unsightly; whereas, the vascular nævus, unless at once removed, is very liable to become a formidable evil. They may, for the most part, be treated in the same manner, and on the same principle as common nævi; but, when situated on the eyelid itself, great care is required in their treatment. All means involving any considerable loss of blood are objectionable; inasmuch as the subjects are, for the most part, of infantile age. In the majority of these cases, the nævi being cutaneous, the destruction of them by escharotics is perhaps the best treatment to be adopted. When the subcutaneous textures are involved, the ligature may be employed; but when completely subcutaneous and very large, injection has been adopted with success. In selecting a remedy, we should give the preference to that which will *effectually* cure the disease with as little subsequent mischief as possible, whether by producing deformity, or what is even a greater evil, by impairing the functions of the parts involved.

ENTROPION.—ECTROPION.

Entropion, or inversion of the eyelids,—ectropion or eversion of the eyelids, if allowed to become chronic, are productive of so much mischief that some means for their removal are imperatively called for, and this end can only be accomplished, in many cases, by the aid of an operation. The causes giving rise to these abnormal conditions of the lids are various, and must be thoroughly understood, before we can hope to remedy the evil. Previous to the decision upon any operation, we should satisfy ourselves that the disease is radical in its nature; not dependent upon any temporary cause, and beyond the influence of palliative measures.

Ectropion may result from, first, thickening of the conjunctiva, the effect either of acute inflammation of that membrane, examples of which appear in the purulent ophthalmia of infants, such examples being temporary only; or of more chronic inflammation, by which the conjunctiva becomes much thickened, and assumes the

character of a granulating surface, or, as it is termed, fleshy; while the skin, excoriated by the discharge, shrinks, and thus draws the edge of the lid outwards. If this condition of the conjunctiva do not yield to the judicious employment of simple remedies, it may be necessary to pare off the thickened membrane, and the consequent contraction produced by the cicatrizing process will tend to draw the lid into its proper position. But when the eversion is considerable, and has existed for any length of time, the tarsus becomes altered in figure, enlarged, and is no longer adapted to the convexity of the globe. To remedy this evil, a portion of the lid in the form of the letter V, composed of the whole thickness, must be excised in the following manner.

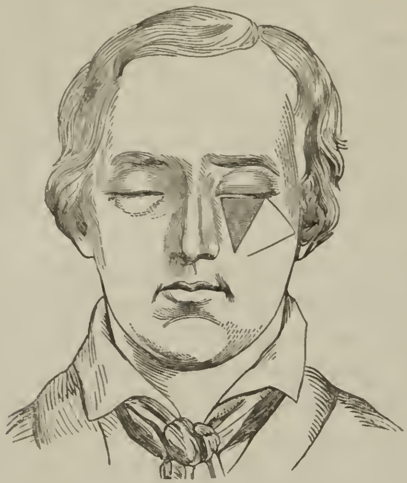
The portion to be removed being held firmly by a pair of tenaculum forceps, two oblique incisions, commencing at the margin, and uniting at an angle near the orbital edge of the bone, or below it, should be made completely through the lid, not with a pair of scissors, as recommended by some operators, for scissors bruise as well as cut, and are always to be avoided in operations where union by the first intention is important, but with a small sharp-pointed knife. The edges of the wound should be accurately united by the finest sutures.

Secondly. A cicatrix, either on the lids, or on the brow, or cheek, the result of ulceration or injury, particularly consequent on burns. In extreme cases of this kind, the deformity is very considerable, the lid being entirely drawn away from the globe, and the tarsus fixed to the cheek. Many different operations have been employed for the relief of this unsightly condition. By freely dividing all impediments, we can often restore the lid to its natural position, but the contraction of the wound, as it heals, reproduces the deformity, and we are often unable, even with the greatest care, to counteract this result. To remedy this, portions of sound integument have been raised and brought on to the wound; such autoplastic operations have proved, more or less, successful in many cases, in the hands of Dieffenbach and others. No particular directions can be given for these operations; each case requiring division peculiar to itself. One remark, however, on the portion of sound skin to be raised may be worthy of mention.

Jaeger, of Vienna, who was the first to perform this operation, brought into position integument reflected from the forehead or cheek, while Dieffenbach improved on the operation, by transplanting

the sound skin laterally, without reversing it; thus in the case of the lower lid, the cicatrix is removed, and the lid liberated *freely*, and elevated, leaving a triangular wound, the basis of the triangle

Fig. 78.



looking upwards; an incision is then carried outwards from the external angle, and parallel with the base, towards the zygoma; this incision being somewhat greater in extent than the base of the wound. From the extremity of this incision another is carried downwards and inwards, towards the lower angle of the wound. The portion of skin thus marked out is detached from the subjacent parts, except at its basis, and adapted to the wound left by the removal of the cicatrix; it is then accurately fixed by sutures, while the space left vacant is treated as in the case of an open wound. This operation, or a modification of it, I should be inclined to recommend in a favorable case, with this addition, the plan being proposed by Chelius, as part of another operation. Two loops of thread are to be drawn through the skin, near the tarsal edge of the lid, and fastened by plaster to the forehead, in the case of the lower lid, so that it may be retained in its natural position for some time during the healing process.

Entropion may result from—first, thickening of the conjunctiva at the point of its reflection from the lid to the globe; thus pushing the orbital portion of the lid outwards, and tilting, as it were, its margin inwards; this effect is often increased by a spasmodic action

of the orbicularis muscle. No operation is called for here, or, indeed, would be of any avail; the judicious employment of remedies will seldom fail in removing the disease. But, in order that these remedies may prove successful, some means must be adopted to remedy the existing entropion, and this may be accomplished by a mechanical contrivance. Adhesive plaster applied for the purpose of drawing up the integument, and a compress on the lid over the thickened membrane, have been employed, but the result has not been successful, in consequence of the action of the secretion on the plaster, and fresh applications become frequently necessary. The intended pressure is much more efficiently accomplished by means of a piece of flexible wire, bent in the form of a pair of spectacles, but with two *semicircles* only, whose convexity is so adapted to the surface as to press on the skin over the thickened membrane, and this portion may be covered with lint or wash-leather. This contrivance is easily secured to the face.

Secondly. Contraction of the ciliary margin of the lid is sometimes the result of protracted ophthalmia tarsi; the tarsus becomes corrugated and shortened, and the ciliæ, turned inwards towards the globe, cause an intolerable amount of irritation. In a slight case, where the mischief does not extend deeply, it may be sufficient to remove a portion of the skin along the margin, either by strong acid, or by the preferable agency of a sharp knife. "With a view to make the operation more effectual, a portion of the orbicularis should be removed also, that a firm cicatrix may be produced."*

In severer cases, however, other means must be employed. An operation has been recommended by Mr. Crampton, and followed with little modification by Mr. Guthrie, of a rather extensive nature, considering the parts dealt with. Two perpendicular incisions are made through the entire lid, with a strong pair of scissors, one on either side of the inverted portion, the internal incision being made external to the punctum. This division sets the contracted ciliary margin at liberty: a portion of the external skin between these incisions, and just above the margin of the lid, is removed (as in the operation elsewhere described), and the edges of the wound are united by sutures, which are left of sufficient length to be carried upwards (in the case of the upper lid), and confined on the brow, thus elevating the liberated portion. Should the tarsal cartilage not

* Lawrence on the Eye, p. 129.

readily yield to pressure, a small incision may be made in each edge. The sutures are left to separate by ulceration, and the vertical incisions to granulate. The wound is dressed with simple cerate.

Mr. Ware simply made a perpendicular section through the whole substance of the lid, near its centre; this, of course, is followed by a separation of the edges of the wound, which presents an outline similar to that of the letter V; and this is gradually filled with granulations. Mr. Tyrrel has also performed this operation both on the superior and inferior palpebræ, with perfect success.

There is another operation which is certainly effectual in removing the prominent evil; viz., the irritation caused by the inverted eyelashes. This is excision of the portion of the lids containing the bulbs of the ciliæ. Mr. Saunders, Mr. Tyrrel, and others, have proposed to remove the entire tarsus, but this is unnecessary, and therefore unwarrantable; a modification of the operation for trichiasis answers every purpose. Entropion here exists, in addition to trichiasis, and the same principle will apply to both. The incision through the skin may be made at a greater or less distance from the border, in proportion as the skin is more or less redundant; and the dissection in this case is carried obliquely into the margin; care being taken to avoid the mucous membrane, which should be left entire. The wound must be closely united by sutures, and should the condition of the tarsus oppose this relation, a perpendicular incision, through the whole border of the lid, may be made at each extremity of the wound. These incisions should not extend further than is absolutely requisite, and, if possible, had better be avoided altogether.

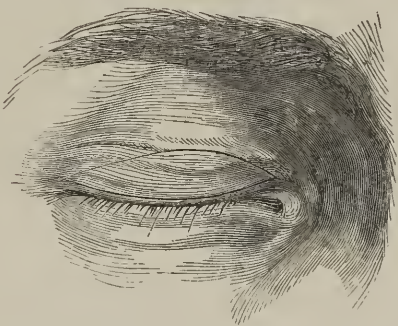
Thirdly. Ulceration upon the inner surface of the lid is also mentioned as a cause of entropion. It will need no special treatment.

Fourthly. Entropion is sometimes the result of redundancy of the skin of the cheek; this occurs for the most part in elderly persons (entropium senile). The subcutaneous fat is absorbed, the skin of the lid loses its elasticity, and falls into folds, and inversion results: the ciliæ are thrown inwards, but produce little irritation. To remedy this condition, it is necessary to remove a portion of the superfluous skin, and by bringing the edges of the wound together, to restore the lid to its proper position. The removal of the skin may be effected either by means of strong acid or by the knife. If the escharotic be preferred, the lid being carefully dried, strong sulphuric acid

should be applied upon a piece of hard wood, brought to a point, like a pencil, in transverse lines, extending the whole width of the lid, commencing about one-eighth of an inch from the attachment of the ciliæ. Great caution must be employed to prevent the action of the acid from extending beyond the limits required. The portion of integument destroyed first becomes white and corrugated, and then brown; it afterwards separates, and ultimately leaves a cicatrix, which is not very conspicuous, and well answers the intended purpose. We should determine, before the application, the extent of surface it is necessary to destroy, by pinching up a portion of the skin, so as to restore the lid to its proper position.

But this method is more painful and uncertain than that with the knife. A sufficient portion of the loose skin of the lid is pinched

Fig. 79.



up by means of blunt forceps, constructed for the purpose, and removed with a sharp knife; the edges of the wound are accurately brought together by means of the finest sutures, and wet lint applied. We determine the extent of our incision by the redundancy of the skin, and the piece of integument ought to be removed near the margin of the eyelid. Some surgeons (Dzondi and Velpeau) have practised the excision of a vertical fold, but the transverse one, in the majority of cases, is more effectual. When the lid has been long everted and has undergone a change of figure, the removal of a portion of the skin will not always succeed, for in a short time the entropion is re-produced. It is desirable, therefore, should the former attempt fail, after excising the integument, to remove a portion of the orbicularis muscle, the action of which seems to exert much influence in prolonging the mischief; the subsequent cicatrix

is deeper and firmer. In all these operations, we must be careful to remove just so much of texture as is requisite, and no more, lest in curing one evil we substitute another. If too little be removed, the entropion remains uncured; if too much, ectropion will follow.

Lagophthalmos, an inability to close the eyelids, may, like one form of ectropion, result from the contraction of cicatrices, in which case the operation for that affection is applicable here; it may also arise from inaction of the orbicularis muscle, through paralysis of the portio dura, and is then to be treated by other means.

Ptosis, or falling down of the upper eyelid, most frequently arises from paralysis of the third nerve, and is often the precursor of some much more serious evil; but it may result from a redundancy of the integument of the lid, from injury to the levator palpebræ muscle, or it may be congenital, depending upon an imperfect development of the muscle. When dependent simply on a redundancy of the integument, an elliptical portion of the skin, of sufficient extent, may be removed, as in the operation for entropion. Little, I believe, can be done in the other cases; but, should ptosis exist independently of any detectable disease, if other treatment fail, it has been recommended that an elliptical portion of the skin of the lid *near to the brow* be removed, and the edges of the wound accurately united, so as to subject the lid to the action of the occipito-frontalis muscle.

Ancyloblepharon, or preternatural union of the lids, is sometimes, though rarely, congenital; it is much more often the result of ulceration. It may be complete or partial. The only remedy is a careful division of the united surfaces; but very great difficulty is experienced in preventing them from uniting again during the process of healing. They must be separated as frequently as possible, and the raw edges covered with some simple cerate. The partial union which arises from ulceration is fortunately seldom of sufficient extent to absolutely require interference. When the union is incomplete, the operation is performed by passing a director under the united surfaces, stretching the lids, and dividing the united parts, cutting accurately in the line of junction, and taking care to avoid the tarsi. When the affection is congenital, should no aperture exist at the internal angle for the introduction of a director, the eyelids must be pinched up off the eyeball in a vertical fold, the surgeon securing one, and the assistant the other; and the united edges separated at the part. Through the aperture thus formed, the director can be passed, and the division accomplished as before.

Symblepharon,—union of the lid to the eyeball, is usually the consequence of injury of the conjunctiva, from the action of escharotics, as lime; but it may result from ulceration of the two opposed surfaces, from whatever cause. The cornea is often involved. The union may be extensive; the entire lid may be fixed to the globe, or consist merely of one or more slender bridles, passing between the surfaces. These, and also the more extensive union, may be divided; but it is even more difficult in this case than in the former to prevent the recurrence of the union. Symblepharon may exist in combination with ancyloblepharon. To determine this, when ancyloblepharon is partial, the opposed surfaces may be examined with a probe; when the union of the lids is complete, they must be pinched up, and the patient directed to put in motion the eyeball, and notice taken whether or not it moves free and independently of the lids.

Epicanthus is a congenital peculiarity: a fold of skin extends more or less vertically from the side of the root of the nose over the inner canthus of the eye, the margin of the fold is crescentic, and is gradually lost in the eyelids: it is usually from one to two lines in breadth, and perhaps limits slightly the separation of the eyelids. I should hardly imagine an operation can ever be required; one has, however, been performed, consisting of a vertical excision of an elliptical piece of skin, external to, and on a level with the fold, and then uniting the edges of the wound.

Trichiasis,—a growing-in of the eyelashes against the globe, the border of the eyelid remaining in its natural position; and *districhiasis*, in which the misdirected eyelashes are disposed, not very regularly, in a row distinct from the others,—admit of relief only from operation. The affection may be complete or partial, varying from a single eyelash to the whole row.

The faulty hairs may be removed. This operation is best accomplished with broad-pointed forceps. The eyelid being slightly everted, and drawn from the eyeball, the surgeon removes each hair singly; seizing it as near to its root as possible, and pulling steadily till it comes out. If the effort be too sudden, the eyelash is apt to be broken, in which case the remainder must be seized as before, and removed; for, if left, it would create more irritation than the entire eyelash. If both lids require this operation, the surgeon should commence with the lower. This remedy is only palliative, the eyelashes being reproduced. If the case requires a more effectual remedy, the operation of extirpating the bulbs of the inverted ciliæ

must be resorted to; and it is accomplished in the following manner. The lid being supported and extended on a smooth piece of horn, adapted to its under-surface, is retained there steadily by an assistant, who fixes the eyelashes against it, with the thumb-nail of the hand supporting it. This, however, is not absolutely necessary, as the lid may be steadied by a pair of forceps at either extremity; taking care not to injure the lid, and especially avoiding the punctum. The surgeon, with a small sharp-pointed knife, makes an incision parallel to the border, and about one line and a half from the anterior margin, down to the cartilage, in length equal to the extent of the inverted ciliæ; each extremity of the incision is continued to the margin. The narrow flap thus marked out is seized with forceps, and dissected clean off the cartilage, towards the margin of the lid, great care of course being taken to avoid the punctum and canalicule. The detached flap is now to be cut away from the margin of the lid, leaving room for the insertion of sutures; these, however, are not always used or required. The divided parts bleed very freely, and must be frequently sponged during the operation, in order that the surgeon may view the divided parts. A careful examination must be made to ascertain that no bulb is left behind; should this occur, it would be seen as a black point, which should be seized with fine-pointed forceps, and removed. The edges of the wound had perhaps better be united with the very finest sutures, and a wet cloth laid over the wound.

When but a few eyelashes have been turned in, the excision of a V-shaped portion of eyelid has been practiced; this is unnecessary, as the preceding operation is adapted to all cases. Some surgeons destroy the bulbs by puncturing them and introducing a point of nitrate of silver. When only one or two eyelashes are affected, this plan is, perhaps, not objectionable.

The eyelids, more especially the lower, in common with the skin of the cheek, are sometimes the seat of cancerous disease; here the only remedy likely to be of service is complete extirpation of the diseased structures, the knife cutting through the healthy parts around. When the disease is limited to a small extent, powerful escharotics may be employed, but the experience of the greatest authorities in these matters is in favor of excision. It is sometimes remarkable what a large portion of the eyelids may be removed, and the eyeball still remain, after recovery, tolerably well protected by the elongation of the remainder.

CHAPTER XXVI.

ON OPERATIONS ON THE CONJUNCTIVA, CORNEA, AND IRIS.

EXAMINATION OF THE EYE. — LODGMENT OF FOREIGN BODIES. — PTERYGIUM.—PROLAPSUS IRIDIS.—PARACENTESIS OF THE CORNEA.—STAPHYLOMA.—ARTIFICIAL PUPIL.—VARIETIES OF OPERATIONS FOR.—AFTER TREATMENT.

SIMPLE as the subject may appear, a few words upon the best method of examining the surface of the globe and interior of the lids will not, I conceive, be misplaced. Much depends on the manner in which this is effected, both as regards the amount of inconvenience or even pain given to the patient, and also the extent of view obtained by the surgeon of the parts he intends to explore. We examine the eye for two different purposes:—(1) to ascertain whether any foreign body is lodged within the lid; (2) to ascertain the exact condition of the organ in disease. In the first case, we have usually to deal with a healthy eye, and our examination must be minute and complete. The patient should be seated in a good light, with the head a little reclined, and in such a position that the light falls obliquely upon the globe from the temporal side. He is then desired gently to close the lids; and the surgeon, placing his forefinger upon the centre of the lower one, immediately below the ciliary margin, draws it downwards, without effort, upon the cheek, and thus obtains a perfect view of its internal surface. Having satisfied himself as to its condition, he next proceeds to the examination of the upper lid, raising it in the same manner as he depressed the lower one, and employing the thumb of the other hand for the purpose. Thus a full view of the anterior surface of the globe is obtained, which may be assisted by directing the patient to move the eyeball in different directions. A complete examination of the interior surface of the upper lid, however, cannot be effected by this simple method; we must evert it. For this purpose the surgeon holds the eyelashes with the thumb and forefinger, and

draws the lid downwards, and a little from the surface of the globe: then pressing a probe gently upon the surface along the upper or orbital edge of the tarsal cartilage, he draws the lid upwards, over the probe, which is then removed. When the examination is completed, the lid is replaced by simply drawing it outwards and downwards.

Foreign bodies, as minute particles of flint or steel, often adhere to, and are imbedded in the conjunctiva, covering the cornea, and are sometimes not discovered when we look directly at the eye, but are readily detected when the organ is viewed obliquely. If any particle be discovered, it should be extracted, provided the removal can be effected without much violence to the eye. The point of a probe or a cataract needle may be used for the purpose, the patient being directed to fix his eyes upon some object before him. Should the minute substance be imbedded in the conjunctiva, over the cornea (as indeed is most frequently the case), we must endeavor to detach it with the point of the needle, with the greatest care; and if we do not succeed, after one or two efforts, we had better leave it to be detached by ulceration, employing in the meantime every means to avert inflammation. Unsuccessful attempts many times repeated may effect much mischief. If a particle of iron or steel remain for some time adherent to the cornea, it becomes oxidized, and after the minute particle has come away, the stain and the depression left behind are often mistaken for the body itself: we should be careful to avoid this error, by examining minutely the doubtful point obliquely. The resources of nature for the removal of all objects hurtful to the organ of vision are abundant, and a beautiful example of this power is here presented to us. When particles of dust or other matter lodge in the eye, the organ is rubbed with some violence, it then becomes congested with blood, and the pain is increased. It is far more prudent to leave the eye untouched, and to refrain from interference. Nature takes cognizance of the evil. The conjunctiva is irritated by the extraneous substance, an increased secretion from the lachrymal gland is the result, the eye is suffused with tears, which escape at length over the lid, and the cause and effect are removed together.

The examination of an inflamed eye must be conducted in a somewhat different manner from that above described. The sensibility of this delicate organ is then greatly increased, and becomes intolerant of the least violence. To effect this, the eversion of the

upper lid is, with some exceptions, unnecessary, and often impracticable. All that is requisite is to obtain a sufficient view of the globe, and as much of the interior of the lids as we can expose by separating them in the manner described; in doing this, we must be careful not to press them against the globe, but should accomplish our object with a light hand. We should also be cautious not to raise the upper and depress the lower lid too greatly at the same moment, lest, by stretching the angles of the eyelids, we cause unnecessary pain. We should avoid a prolonged examination at one time; repeating it, if necessary, after a short interval of rest, rather than give cause of complaint, or retraction of the head. An inflamed eye should not be exposed to a larger quantity of light than is absolutely necessary. We often defeat our own object by not attending to this rule; we do not require excessive light for the purpose, and the patient will often permit a full examination of an inflamed eye in a moderate light, while in a stronger one, spasmodic action of the orbicularis muscle completely baffles all attempts to obtain a sufficient view of the organ. In cases of strumous ophthalmia, this is especially observed: we should carefully shade the eyes from light, if we wish to obtain a good view of the globe. It requires some tact to obtain a view of the cornea in infants affected with purulent ophthalmia; it is of great importance to accomplish this, in order to ascertain the condition of the membrane. The application of more or less force is often resorted to for this purpose, but in my experience is always unnecessary, and, for the most part, unsuccessful. A nurse should hold the child on her lap, while sitting; the child's head should rest between the knees of the surgeon, a towel having been previously thrown across them. The eyes should be shaded from the light for a moment or two, and when the child is tranquil, and ceases to resist, let the lid be separated *quickly*, in the manner before described. A little practice is necessary to accomplish this adroitly. The child is taken by surprise; we obtain only a momentary view, but sufficient for the purpose. If necessary, it may be repeated. This method is, I conceive, much preferable to any attempt at forcibly separating the lids; consequent on which effort the child struggles, the orbicularis contracts violently and spasmodically, the lids are forcibly closed, and become everted, and the eye being rolled upwards and inwards, we see nothing beyond an inflamed and swollen conjunctiva.

Many diseased conditions of the eye may be examined in a strong

light, without any inconvenience to the patient, and with advantage to the surgeon; as cataract, glaucoma, amaurosis, &c.

Pterygium—a peculiar alteration of the ocular conjunctiva, of which membrane a triangular portion, with the apex most frequently directed towards the centre of the eye, becomes thickened and elevated. It is sometimes transparent, sometimes red and fleshy. It often encroaches on the cornea; but Mr. Lawrence asserts, that he has never seen it so far advanced as to impede vision. If it do not yield to other treatment, it may be removed. The eye being a little turned in the direction of the disease, the growth is to be seized and slightly raised with tenaculum forceps; a small, thin, and narrow-bladed knife is then passed through the base, with the edge towards the cornea; the pterygium is separated from the sclerotica, as far as the margin of this structure. The edge being then turned upwards, the knife cuts its way out, dividing the abnormal substance, and leaving the portion attached to the cornea untouched. The flap thus formed is elevated, and the separation from the globe completed, in the direction of its base or outer attachment, close to the sound membrane. The portion remaining on the cornea is left untouched, and gradually disappears. Should the operator incautiously excise this portion, an opaque deposit will result, which will prove an evil as great as the pterygium itself. Cold or tepid water is generally the only after application required; sometimes, however, simple astringents are useful.

Polypi-Warts, and other excrescences of the conjunctiva, are occasionally, though rarely, met with. They are easily removed, by being seized and slightly raised by means of forceps; their base is then detached from the conjunctiva.

Prolapsus iridis is sometimes the immediate effect of penetrating wounds of the cornea: the iris must be returned if possible. By exposure of the eye to a strong light the iris may contract, and thus free itself from its contact with the wound. If this attempt fail, the eyelids should be closed, and after gently rubbing the upper lid over the cornea, the eye should be suddenly opened to a bright light. This method occasionally succeeds. Should the pupillary margin be entangled in the wound of the cornea, the effect of belladonna to the brow may be tried. But it should be remembered that the action of the iris is much impaired by the loss of the aqueous humor, having now to contend against the resistance of its own weight, besides the impediments caused by contact with adjacent

parts. All attempts to force back the protruded portion of the iris by means of a blunt probe, &c., almost invariably fail; and unless such endeavor be made very gently and cautiously, there is great risk of additional protrusion. Sometimes the prolapsed portion is so tightly embraced by the edges of the wound that this means affords little prospect of success. In such a case, the portion external to the cornea may be removed with a pair of scissors, and especially so if it consist of the pupillary edges, and then the effort at reduction may be repeated. By this proceeding, we may preserve the cornea, although at the expense of the pupil. By leaving the iris protruding, synechia anterior, contracted pupil, greater or less opacity of the cornea—if not partial staphyloma—will in all probability result.

Foreign bodies may pierce the cornea without passing through its substance, and project into the chamber, or they may pass completely into it, and either lie freely at the bottom, or become fixed in the iris, or crystalline lens. Their removal is, of course, urgently indicated; but it is not always easy to accomplish this, especially after some time has elapsed; but coarse manipulation will greatly aggravate the evil. Should any portion of the foreign body protrude externally, it may be withdrawn without much difficulty; if it have completely entered the chamber, it may be extracted through the wound of the cornea, if that be sufficiently large, by means of a small hook or delicate pair of forceps. If the wound be too small for that purpose, and be so placed that its enlargement would not be advisable; or, if it be healed, a clean section of the cornea, near its margin, of sufficient length may be made, with a cataract knife, in the position most convenient for extracting the foreign body, which may escape with the aqueous humor in the process of division. Extraneous substances remaining in the eye sometimes become enclosed in a capsule of lymph, and cease to cause irritation. Small particles of iron or steel may become oxidized and dissolved.

Paracentesis of the cornea, or evacuation of the aqueous humor, is an operation very seldom required. It may be performed either with a broad double-edged needle, or a narrow cataract-knife. The instrument is to be introduced, with the flat surface forwards, near the margin, and in a direction towards the centre of the pupil. Care must be taken that it penetrate the cornea, and not pass between its layers. The point of the instrument should not penetrate into the anterior chamber as far as the iris; but as soon as it has

passed through the cornea, the handle should be depressed, so that the long axis of the blade be more parallel to the surface of the iris. The instrument may then be pushed a little further on, if a larger opening be required. By slightly withdrawing and rotating it on its axis, the aqueous humor is allowed to escape. The instrument is withdrawn before the iris can fall against it. There is often great difficulty in exposing the eye sufficiently for the performance of this operation; it is generally exceedingly painful and intolerant of light. The patient is placed in the same position, and the eye exposed, as in the operation for extracting a cataract.

Staphyloma consists in an increase of size, with change of figure in the cornea; this structure becomes more prominent, and is almost invariably opaque, with adhesion of the iris to its posterior surface. It may be partial or complete; in the former case, the use of the knife is seldom if ever necessary; paracentesis corneæ, however, is sometimes useful. In total or complete staphyloma, the treatment may be either palliative or radical. The former consists either in subduing the inflammation or puncturing the cornea. Sometimes, indeed, repeated puncturing is very beneficial; the eyeball shrinks and becomes quiet; but the operation more generally fails, and some other effectual plan of treatment is required. The radical cure consists in shaving off the projecting portion, which is to be accomplished in the following manner. The patient, being placed in the sitting posture, reclines his head against the breast of an assistant, who supports it, and freely separates the lids. The operator, commanding the globe, by passing a hook through the staphyloma, transfixes the centre of its base with a cataract-knife, the edge being turned upwards. Having divided the upper half, he raises it by means of the hook, and completes the section of the lower portion. When the first incision is made, the aqueous humor escapes. The removal of the staphyloma is usually followed by the escape of the lens, and a portion of the vitreous humor. As soon as the operation is completed, the lids should be closed, and wet lint applied over the orbit, and the patient placed in bed and kept perfectly quiet. Should inflammatory symptoms arise, they must be combated. Sometimes the operation is followed by a good deal of hemorrhage, in consequence of division of the abnormally vascular iris; for this reason, it is not desirable, says Mr. Tyrrel, to perform the operation on a child of feeble power; who also warns the operator not to interfere with the sclerotic tunic, having observed severe suppurative

inflammation to follow in several cases in which that coat has been divided. The assistant who separates and fixes the lids should avoid pressing on the globe, for, if the entire of the vitreous humor escape, the subsequent collapse is so complete as to afford but an indifferent support for an artificial eye. Sometimes a fungus grows from the wound, which readily yields to the application of caustic. Should the closed lids become distended by blood, after the operation, the clots must be removed. The result of this operation is, that the coats of the eyeball collapse, the whole globe shrinks, and forms a small tubercle in the orbit, and the eyelids recede. An artificial eye is adapted to the remains of the natural one, and may be made to resemble it so perfectly that the deception is not detected by casual observers. The muscles of the globe still continue to act upon the shrunken mass, and the artificial eye partakes of its movements, and acts in harmony with the natural one. The lateral movements are generally best performed, the vertical ones being less perfect. The artificial eye is introduced by first passing the upper edge under the upper lid, and then by depressing the lower lid it is received into its place. It produces at first a little inconvenience, but rarely any great amount of irritation. These are not the only cases adapted for the use of an artificial eye. It may be worn whenever the natural eye has been destroyed as an organ of vision, and reduced sufficiently in size for the purpose; all morbid action, of course, having ceased.

FORMATION OF AN ARTIFICIAL PUPIL.

In certain cases it becomes expedient to alter the position of the pupil, or to form a new pupillary aperture. An artificial pupil is an opening made in the iris, serving as a substitute for the natural one, when the latter is either obliterated, or by other changes in the iris, or in the surrounding parts, rendered useless for the purposes of vision. The formation of an artificial pupil is an operation requiring the greatest delicacy of manipulation, and its success depends very much upon its skilful performance. The states of the eye requiring the operation are various; simple closure of the pupil, obliteration of it by adventitious substance, with or without adhesion of its margin to an opaque capsule, contraction or closure of the pupil with synechia anterior, partial staphyloma, leucoma, or any two or more of these combined, are examples of the result of disease,

in which vision is often greatly benefited by an operation. Before undertaking to form an artificial pupil, we should convince ourselves that the morbid condition of the eye is beyond the influence of other remedies, and that the integrity of the nervous structures of the eye is unimpaired. This operation merely provides for the admission of light, and has no power beyond this of restoring sight. The patient is always able to distinguish light from darkness, provided the retina be healthy, whatever may be the obstruction requiring the operation. If, therefore, he be unable to detect the presence of light, all hope of benefit from an operation had better be abandoned. The globe should be natural both in size and consistence. If the natural texture of the iris be destroyed, at least in its outer circle, the prognosis is unfavorable. The various conditions requiring the formation of an artificial pupil are mostly the consequences of inflammation; we must take care, before operating, that this and all other disease be completely subdued, and bear in mind the liability to return of inflammation at any period shortly after recovery. "The formation of an artificial pupil," says Beer, "is indicated in those cases only in which the blindness is caused merely by the closure, or the obstruction of the normal pupil, when the sensibility to light is unequivocal, when no other deviations exist from the natural form and structure of the globe, which might render the operation extremely difficult or impracticable, when the previous inflammation has been long and completely terminated, when the patient is in other respects healthy, and does not exhibit any marks of scrofulous, syphilitic, or arthritic disease."* Indeed, the patient's state of health must be particularly observed.

When one eye is sound, it is not advisable to operate; for, even supposing the operation to succeed, the patient will not be benefited, as he will, of course, prefer the use of the sound eye. Supposing one eye to be irrecoverably lost, it is not advisable to operate on the other, provided any degree of useful vision remain, as complete blindness may result. If all useful sight be lost, the experiment may be tried; if both eyes be affected, we must be content to operate on that which is least damaged. It is of little use to proceed on both, as the sight of one is almost certain to be more perfect than the other, and the more perfect will be generally used.

The success of these operations is always very doubtful; for it is

* Quoted from Lawrence on Diseases of the Eye.

a violence done to a sensitive organ, which has already been the subject of inflammatory disease, is often specific in its character, and especially liable to relapse. Those cases promise most success in which the condition of the eye requiring the operation is of a traumatic origin, or the result of purulent ophthalmia. We cannot always determine the condition of the posterior parts of the eye, and are sometimes obliged to operate in considerable doubt on this point. The case is more favorable in proportion as the imperfection of vision is simply dependent on obstruction of the pupil, while the other parts are sound. The sight, even in the best cases, is only partially restored. Much will depend upon the central position in which we make the opening; the nearer its approach to the centre, the more complete will be the recovery. Next to the centre of the iris, is the nasal side, on the level of the natural pupil, to be preferred; next in order, the temporal, then the lower part, and, lastly, the upper, which is most objectionable. In general, also, sight will be increased in proportion to the size of the new pupil, which will always contract for some time after the operation.

The various states of the eye rendering the formation of an artificial pupil necessary require corresponding diversities in the mode of performing the operation. Almost every case presents something peculiar, and the remedy must be adapted to it. The methods described are almost endless; some authors enumerate forty or fifty, and the list might be augmented. It would be a useless task to enter into a description of these varieties. I shall describe the principal operations usually practised, mentioning the cases to which they are severally applicable, of which all the operations spoken of by authors are modifications, and have arisen out of the necessity of individual cases. Much depends, of course, upon the proper application of these methods; "the surgeon should be always careful to select that operation which occasions the least violence to the organ, provided that it be likely to succeed."*

There are four principal methods of operating:—1. Alteration of the position of the natural pupil. 2. Incision of the iris. 3. Excision of a portion of the iris. 4. Separation of the iris from the ciliary ligament. All the operations described are modifications of one or other of the above.

Sometimes the pupil is dragged from its natural situation behind

* Tyrrel on the Eye, vol. ii. p. 518.

an opaque part of the cornea by bands of false membrane (synechia anterior); and it is in some cases practicable to divide these, in order to restore the pupil to a point corresponding with a transparent part of the cornea. A double-edged needle, gradually increasing in breadth from the point, is passed through the cornea, and the adhesions divided. The greatest care must be taken not to injure the lens, and this is easily avoided if the aqueous humor do not escape, but not otherwise. And in order to guard against this accident, it has been recommended to puncture the cornea obliquely.

Sometimes opacity of the cornea exists immediately in front of the pupil, to such an extent as to cover it, even when dilated by belladonna; and in order to restore vision, it becomes necessary to alter the position of the pupil, so as to bring it opposite a transparent part of the cornea. Mr. Tyrrel remarks, that "when the position and extent of the opacity of the cornea do not preclude it, the pupil should always be brought downwards and outwards;"* and he also recommended the operation in cases of conical cornea, where accurate perception of minute objects is lost.

The operation is thus performed:—The patient is placed in the same position as in an operation for cataract; a broad needle, so held that one flat surface shall be parallel to the surface of the iris, is passed through the cornea, close to its margin, at that part towards which it is intended to bring the pupil. The instrument should fairly enter the anterior chamber, but should not be passed so far backwards as the pupil. The iris should be of course avoided; and in order to effect this easily, as well as to obviate difficulty in the subsequent part of the operation, as little of the aqueous humor should be allowed to escape as possible. The needle being carefully withdrawn, a fine blunt hook, with a long bend (such as was used by the late Mr. Tyrrel), is to be passed through the opening, into the anterior chamber, as far as the pupil, with the bent limb, forwards. The extremity of the hook being introduced through the pupil, the bent part of the instrument is to be turned backwards by half rotating the handle between the finger and the thumb. The pupillary margin of the iris is then to be caught by the hook, and immediately the instrument is to be carefully withdrawn. When it arrives at the aperture in the cornea, its passage is liable to be impeded while the point is directed backward; it may then be half

* Tyrrel on the Eye, vol. ii. p. 500.

rotated, as before, so as to bring it into the position in which it entered the anterior chamber; but in effecting this object, the hook should not recede from the opening in the cornea, lest the iris escape. Sufficient of this membrane should be withdrawn through the aperture to effect the desired change in the pupil, and the portion external to the cornea cut off by a fine pair of scissors. Some operators leave this to separate by ulceration; but by cutting it off, a great source of irritation is avoided; and if the portion so withdrawn should happen to recede, the pupil may regain its original position. This is not, however, likely to happen if the opening in the cornea be not too large, which rarely occurs if made with the needle above described.

Sometimes when the natural pupil has been diminished or displaced, as in synechia anterior, a mere fissure in the iris has resulted from the performance of the above operation, insufficient for the purposes of vision. A second operation performed on a similar plan often succeeds in restoring sight. An opening in some other part of the cornea is to be made (if the first operation has been performed at the outer and lower part, this may be undertaken above the centre), and the margin of the fissure seized and drawn through it, thus converting the pupil into a triangular one. There is usually more difficulty in this second operation in avoiding the capsule of the lens, but it may always, I believe, be accomplished with care. In many cases after the operation, the use of convex glasses greatly assists the sight, for minute objects. This results, probably, from the alteration in the distance between the lens and cornea, the latter being somewhat flattened.

In some cases of synechia anterior, the pupil is altogether lost, when a modification of the preceding operation may be practised with success. The needle used to puncture the cornea may be made to penetrate the iris, close to its adhesion to the cornea; the greatest care being taken not to pass the point of the instrument backwards, the capsule of the lens being nearly, if not quite, in contact with the posterior surface of the iris, in most of these cases. Immediately afterwards, without losing sight of the puncture made in the iris, the blunt hook is to be introduced as before described, passed through the aperture, and withdrawn. Usually the iris tears a little from the point seized by the hook. The great difficulty of this operation consists in avoiding the capsule of the lens, any violence done to which is followed by cataract. When a very small portion of the

cornea remains clear, the opening may be made into the anterior chamber, through the margin of the opacity, and, if necessary, the iris may be punctured, near to the ciliary ligament, and drawn from that point to the opening in the cornea. This operation does not succeed so perfectly as when the pupil is formed nearer to the centre; the ciliary processes in the latter case obstruct the passage of light, but the risk of wounding the lens is somewhat less. As to the size of the portion of the iris to be withdrawn and excised, we should be guided in a great measure by the circumstances of the case. We should endeavor to render the new pupil, if possible, at least equal in size to the natural one, bearing in mind the fact that, although we cut off only a small portion, the remaining aperture will be considerably larger.

What remains protruding after the necessary portion is removed, is sometimes carefully pressed back with the curette, the eyelids are then gently closed, and suddenly opened to the light; this is done for the purpose of disentangling the iris from the wound in the cornea, and setting it free. If it be intended to adopt this plan of operating, the corneal section should be more extensive; a keratome or cataract-knife being used. The escape of aqueous humor, which follows, is sometimes accompanied with spontaneous prolapse of the iris. The portion of iris withdrawn should be raised with fine forceps and excised; care being taken to include a portion of the pupillary margin.

The formation of an artificial pupil, by means of incision of the iris, is best adapted to those cases in which the pupil is closed, whether by the organization of lymph, the result of inflammation, or in consequence of prolapse of the iris, the cornea being in its natural state of health, or, at least, a considerable portion of it transparent, and the lens removed. This condition of parts is sometimes met with after the removal of a cataract. If the lens be present and transparent, this operation is to be avoided, if possible, and some other adopted, as the lens are very liable to be wounded in the act of making the incision in the iris. The artificial pupil is formed either by means of a single incision, or of two incisions meeting at an acute angle. In order that a single incision may succeed in the formation of an aperture of sufficient extent, the texture of the iris must be healthy, at least in its outer circle, so that its fibres may retract when divided; and for the same reason the iris should be on the stretch, otherwise the double incision is to be preferred.

A single incision may be made in the iris, either through the sclerotica or cornea. The operation through the sclerotica was revived and practised by Sir W. Adams, who invented for the purpose his iris scalpel; this is a small, straight, slender knife. It is thus performed: the patient is placed in the same position as in the operation for cataract; the surgeon supports his hand by the little finger on the cheek, and holding the knife in such a position that the edge is directed backwards, he pierces the sclerotica on the temporal side, about one line or a line and a quarter behind its margin, in the line of its transverse diameter. We are generally directed to puncture the sclerotica, either just above or below its transverse diameter, in order to avoid the long ciliary artery. But the external long ciliary artery, at about the distance of two lines from the posterior margin of the ciliary ligament, divides at an acute angle into two branches, an upper and a lower. The artery, therefore, is out of danger, and we avoid wounding the branches if we puncture the tunics in the line of the transverse diameter. I need scarcely add, however, that it is exceedingly difficult to do this. Too much importance has been attached to this point. Mr. T. Wharton Jones has correctly described this division. (*Ophthal. Medicine and Surgery*, page 278.)

The knife is to be pushed on towards the centre of the globe, for about the eighth part of an inch. The handle is then inclined considerably backwards, and the point of the knife, carried on, penetrates the iris from behind, near its temporal margin. As soon as the point appears in the anterior chamber, the handle is brought forward, and the blade passed across the chamber, towards the opposite side. By still inclining the handle forwards, the edge of the blade is applied to the surface of the iris, and by being a little withdrawn, is made to cut it. If the incision, by this movement, is not made of sufficient extent, the knife is to be again carried forwards, and again withdrawn, repeating this movement till a sufficiently large incision be effected, being about one-third the diameter of the iris. In some cases, particularly when the lens is absent, the iris yields so readily to the pressure of the knife, that its division is accomplished with the greatest difficulty. The most delicate pressure should be made against it, lest it be detached from the ciliary ligament. In cutting the iris, care should be taken not to enlarge the wound in the sclerotica, lest the vitreous humor escape. When

the iris is on the stretch, it is readily divided, and the wound immediately gapes and becomes fusiform.

The operation through the cornea is thus performed: a section of this membrane is made at its lower and outer part, near its margin, for about one-fourth of its circumference, with a cataract-knife, in the same manner as in the operation for extraction of the lens (see cataract); a fine pair of scissors (invented by M. Maunoir) is to be introduced through the opening, with their extremities closed. Maunoir's scissors are extremely delicate; they are bent sideways at an obtuse angle, the blade corresponding to the convexity, sharp-pointed, the other, probe-pointed. As soon as they have entered the anterior chamber, the blades should be separated, and the sharp one made to pierce the iris and pass behind it, while the other probe-pointed blade is carried across the anterior chamber. The blades are then closed, and the iris divided. When the new pupil is required to be more or less vertical, the operation through the cornea is preferable, it being very difficult to make a vertical division of the iris through the sclerotica. The vertical incision should be on one or other side of the centre of the iris, in order that the radiating fibres may be divided.

But the operation through the cornea is generally performed for the purpose of making a V-shaped incision in the iris. The incisions may be made in various directions; the circumstances of the case being taken into consideration. Mr. Tyrrel recommends the first incision to be made from the outer and lower to the upper and inner part of the iris; and the second from the commencement of the first, in a direction inwards and a little downwards; the triangular flap thus formed has its apex near to the wound in the cornea. Dr. Mackenzie divides the radiating fibres only, making the incisions meet near the margin of the iris. The triangular portion, in whichever direction it is formed, contracts. The flap should be depressed towards the vitreous body, by means of the scissors, otherwise it may easily reunite; this mode of operation, however, is not consistent with the experience of all surgeons.

The formation of an artificial pupil, by separating a portion of the iris from its ciliary connection, is a more violent operation, and inflicts a greater amount of injury on the eye than any of the preceding ones; and even when successful, is not followed by such satisfactory results, for the marginal pupil is less useful for the purpose of vision than that which is formed near the centre of the iris;

moreover, the anterior extremities of the ciliary processes are somewhat obstructive; so that, although applicable to almost all cases, it ought only to be resorted to when other modes of operating are inadmissible; such as in cases of extensive central opacity of the cornea, in cases in which another operation has been previously performed, and the opening has since closed, and in examples of general synechia anterior, where the transparent part of the cornea is so situated as not to allow of the operation by excision.

The operation has been performed both through the sclerotica and cornea; the former has, however, been abandoned, the operation through the cornea being preferred. Formerly the undertaking consisted in simply detaching the iris from the ciliary ligament, and leaving it; but although in some examples in which the iris is healthy, the opening remains permanent, yet the iris more frequently resumes its former position, or becomes closed, in consequence of inflammation. Some plan for obviating this evil was, therefore, deemed necessary, and the detached portion of iris is either secured in the opening of the cornea, or a portion drawn out and excised.

The performance of this operation is attended with considerable pain; the head must be well secured, and as the surgeon may require the free use of both his hands, the eyelids are to be separated by an assistant, the patient being placed in the same position as for extraction of cataract. The section of the cornea should be at the distance of at least half its diameter from the point at which it is intended to separate the iris; if it be nearer, the cicatrix may interfere with the transmission of light; but if it be made at too great a distance, the separation of the iris must be unnecessarily extensive. The situation at which the iris is to be detached will determine, in great measure, the place and position of the opening in the cornea. The size of the corneal section will depend upon the modification of the operation to be performed; if it be meant simply to leave the iris fixed in the wound, it must not be too large, otherwise it will be necessary to withdraw a portion and excise it. The incision of the cornea may be made with Jaeger's keratome, or Beer's cataract-knife, the point being moved a little towards each angle of the wound, so as to make the incision as extensive within as without. If it be intended to secure the detached portion of the iris in the opening, this should be just sufficiently large to allow of the introduction of the hook; the point of the knife is to be directed at right angles to the surface of the cornea, but as soon as that membrane is

perforated, the handle must be depressed, so as to bring the blade nearly parallel to the surface of the iris, in which direction it is to be pushed on, until an opening of sufficient extent is made.

An immense variety of instruments have been designed for the purpose of seizing and detaching the iris; the simple hook usually employed is preferable to all; this is held like a cataract needle, and introduced with its flat surface through the opening in the cornea into the anterior chamber, with its convexity foremost, care being taken to prevent the escape of the aqueous humor. It is to be carried on quite to the ciliary margin of the iris, when its extremity will be concealed by the edge of the sclerotica. The point is now to be directed against the iris, fixed by delicate pressure, and then slightly withdrawn, so that a secure hold of the iris may be obtained. The texture of the iris is firmer towards its ciliary margin, and the nearer to this border it is transfixed by the hook, the firmer will be the hold obtained. In some cases, however, the texture of the iris is so altered, and has become so soft, that no kind of hook will secure it. Its substance is torn, instead of its margin separating: our only resource is then to seize the iris with a fine pair of forceps, introduced through the cornea, and thus effect the detachment. The hook being fixed, it must be again laid flat, to prevent the iris slipping. A cautious, steady, and gentle effort is now to be made, till the iris begins to separate; the hook is then to be carefully withdrawn, till it, together with a portion of the iris, passes safely through the wound, and a sufficient portion is withdrawn to render the pupil of requisite size. Taking care that the part of the iris between the edges of the wound is fixed there (and this may be effected, in some cases, by drawing it towards the angle of the wound), we detach the hook. If it be necessary to withdraw more of the iris than is required for fixing it in the corneal section, the superabundant portion is to be cut off with a fine pair of scissors. When the prolapsed portion cannot be retained, more should be drawn out and excised. Indeed the allowing the iris to escape, after excising a portion, is sometimes preferable to the other, as in cases of large synechia anterior, &c., where only a third or fourth part of the iris is free, also where considerable inflammation is to be expected. If we intend originally to perform excision, the opening in the cornea should be made rather larger than in the other case.

In performing this operation, in some cases where the iris is adherent, we may so direct the knife as partially to detach it, otherwise

the hook must enter the posterior chamber, and penetrate the iris from behind forwards; great care is then required to avoid the hook being entangled in the cornea. The detachment of the iris is followed by effusion of blood into the chambers, and this is generally pretty considerable: it is removed by absorption in the course of a few days.

The operation for artificial pupil is much simplified, when the lens is absent; it is, however, usually present, in either a transparent or an opaque state. When transparent, it is of course of the greatest importance to retain it, and to adopt a mode of proceeding, if possible, in which there is least chance of wounding it, such as the operation with Mr. Tyrrel's blunt hook, before described. If cataract be present, it is sometimes advantageous to adopt a modification of some of the operations, by which the lens may be broken up or removed, at the same time that the artificial pupil is formed; thus, in Sir W. Adams's operation of incision of the iris through the sclerotica, before alluded to, the lens may be depressed or broken up, and left for absorption; or, in operating through the cornea, the section may be increased and the lens extracted. It is, however, always dangerous to complicate the operation for artificial pupil; the violence done to the organ is already formidable, so that it is best, as a general rule, to deal with an opaque lens by a subsequent operation of depression or absorption, when the eye has fully recovered from the effects of the other.

The previous preparation of the patient for the formation of an artificial pupil should be similar to that for cataract. We should avoid operating, if possible, under any unfavorable circumstance.

Mr. Tyrrel* considered it desirable to submit such patients to a mild alterative or mercurial course before the operation is performed. If there be any effused matter to remove, I agree with him in recommending a previous mild course of mercury; but if such clear indications for its employment do not exist, I would never sanction the employment of this injurious agent, believing that it is competent to great evil, and that it has little power in preventing a recurrence of disease. I should much prefer the efficacy of country air, with nutritious but not stimulating diet; and, if medicine must be employed, I should prefer to give some tonic, as bark.

The after-treatment of these operations is similar to that required

* Tyrrel on the Eye, vol. ii. p. 516.

in the varieties of cataract. The eye, after the employment of the least violent methods, may be cautiously exposed to the light, after three or four days; but this will, of course, depend upon the subsidence of irritation or inflammation. The operation by separation is often followed by so much pain as to require the use of an opiate. The occurrence of inflammation must be carefully observed, and any positive symptoms actively dealt with.—(*See* CATARACT.)

CHAPTER XXVII.

ON OPERATIONS FOR THE REMOVAL OF DISEASED CRYSTALLINE LENS.

CATARACT. — CAUSE. — VARIETIES. — THREE FORMS OF OPERATION. — EXTRACTION. — DEPRESSION. — RECLINATION. — ABSORPTION. — POSTERIOR OPERATION. — ANTERIOR OPERATION. — AFTER-TREATMENT IN EACH FORM. — DRILLING OPERATION FOR OPAQUE CAPSULE. — OPERATION ON INFANTS. — CATARACT GLASSES. — HYDATID IN CHAMBER, ETC.

Cataract, opacity of the crystalline lens, (lenticular,) or of its capsule, (capsular,) or of both, (capsulo-lenticular,) can only be removed by operation. The subdivisions of lenticular cataract mentioned by authors are very numerous, depending on the consistence, appearance, mode of origin, &c. The only division, however, necessary for practical purposes, is that of hard and soft; in the former variety, the consistence is increased towards the centre, and the size of the lens is generally diminished, the space between the lens and iris being more obvious. They are generally of a grayish color, with more or less of a yellowish-brown or amber tint towards the centre. As a rule, the deeper the tint the harder is the cataract, and the grayer in appearance the softer the consistence. This is the form generally met with in elderly people. In the latter variety, the consistence is diminished, (the contents of the capsule are sometimes fluid,) and the size is increased; the lens often coming so close against the iris as to interfere with its movements. They have a milky appearance; are of a grayish-white, or bluish-white color, without any mixture of the yellow tint, and the opacity is generally not uniform, but appears streaked or cloudy, especially at the commencement. This form is most frequently met with in persons under the middle age, and generally causes a greater degree of blindness than the other variety. Opacity of the capsule is always sooner or later followed by that of the lens.

Although an operation is the only means of removing a cataract,

it is by no means to be indiscriminately resorted to. We are not to interfere while the cataract is confined to one eye; even should we succeed, nothing is gained while the other eye remains sound. An operation is called for only when that also becomes affected, which generally occurs at an earlier or later period. It is a general rule not to operate till the cataract is mature, till all useful vision is destroyed, even with the aid of belladonna, and this rule is more especially stringent where one eye is already lost. Before the cataract is complete, the vision of the patient may generally be greatly improved by the application of belladonna, or its active principle, atropine; and this may be continued so long as the patient derives any benefit from its use. A solution of atropine, dropped into the eye, is a much less offensive mode of dilating the pupil than the application of the extract, and is equally effective. When the cataract, however, is mature in one eye, and immature in the other, the former may be operated on, so that the patient may regain vision with that eye while the cataract is forming in the other.

We should ascertain, before undertaking an operation, that the retina is sound; that the patient can distinguish between light and darkness, which power will exist so long as the nervous structure of the eye is healthy. If this power be lost, the operation will be useless. In cases of cataract, combined with amaurosis, in young women, the operation may be undertaken for the purpose of removing deformity; but this is a question to be decided by the patient. An operation should not be performed on both eyes at the same time; for the risk of failure is thereby greatly increased.

The result of an operation for the removal of cataract is so important to the patient that it behoves us especially to render ourselves thoroughly informed on all the circumstances of the case; to examine the eye minutely, that we may, if possible, remove all impediments to success, or duly qualify our prognosis. This will be favorable when the morbid change is confined to the lens, or its capsule, the other structures being healthy, and their functions unimpaired; when the constitution is sound and the health good, and the patient of a spare rather than of a full habit of body, and of temperate habits.

The prognosis is especially good in congenital cataracts, in those of young persons; also in traumatic cataracts, and in the firm species of elderly persons. I need not say how unfavorable is the prognosis, when amaurosis, glaucoma, or synchesis exists, or when

the iris or other parts show signs of disease; or how doubtful when there are symptoms of vascular disturbance about the head, and in cases in which the cataract has been the product of inflammatory action. Should disease exist in the other eye, although the one affected with cataract may in other respects appear healthy, the prognosis must be very guarded, remembering how prone one eye is to assume the morbid action which exists in its fellow. The existence of gout or rheumatism should not be overlooked. The age of the patient should be taken into consideration; the risk is said to be greater at the middle period of life than in the very young or those more advanced in years; except in the very aged, in whom the power of repair is very feeble. All seasons of the year are not equally favorable for operation, and the majority of surgeons avoid operating, if possible, during the colder months.

Before attempting to operate, we make satisfactory inquiries into the state of the patient's health. All morbid conditions of the eye, within reach of our art, must be removed. A few days' rest of mind and body may be recommended. The tongue should be clean, and the secretions natural. The state of the circulation is also important; excess of power should be subdued by rest, spare diet, &c. The abstraction of blood is seldom necessary; but it is better to prevent inflammation than to contend against it. Considerations due to deficiency of power are more often overlooked than the opposite extreme; and this evil is far more difficult to remedy. The circulation becomes feeble as age advances, and in old people the power of repair often proves unequal to the task it is called on to perform. A section of the cornea is sometimes as complete forty-eight hours after an operation, as when first made, and exhibiting no disposition to unite. This want of power must be remedied by generous diet, and the careful employment of stimuli. We must distinguish between action and power, and unless we can succeed in raising the latter, we had better decline the operation altogether. The bowels should be freely opened in the morning before the operation.

There are three different methods of operating for the removal of cataract.

First.—In *extraction*, the opaque body is removed from the eye through a section of the cornea.

This operation is particularly adapted to cases of firm cataract, especially occurring in elderly persons. The cataract is little susceptible of absorption, on account of its consistence, and is removed

at once from the eye, and, under favorable circumstances, the wound in the cornea is healed in forty-eight hours, or less. The patient, however, is unable to employ the eye for some weeks. Thus complete removal of the cataract, and speedy restoration of vision, are the result of a successful operation; but should the operation fail, sight is almost irretrievably lost.

This operation is unadvisable in cases where, from advanced age or other causes, the powers of the system are unable to repair the injury sustained; where there is doubt of union of the wound of the cornea; also in cases of habitual cough, or difficulty of respiration, causes not only liable to interfere with the perfect performance of the operation, but also rendering the result extremely doubtful. Where the patient is unmanageable, whether in consequence of early age or great obtuseness of intellect; in cases of unsteadiness of the eyeball, where the globe is sunken, whether from the absorption of the fat behind it, or from unusual prominence of the brow, or when the palpebral fissure is unusually small, these causes render it extremely difficult to make the section of the cornea; so, also, in cases where the anterior chamber is very small, whether from a flattened cornea, or from projection of the iris, in consequence of the cataract behind; this, however, is not a frequent occurrence, as the hard cataract, which is best adapted for the operation, is generally small; but unless the anterior chamber is moderately deep, the danger of wounding the iris is great. Where the iris is adherent, either to the cornea or to the capsule of the lens, or where the pupil is habitually contracted, interfering greatly with the extraction of the lens. In cases where the globe, although possessing all the appearance of health, feels soft and flaccid when touched, indicating, in all probability, unusual fluidity of the vitreous humor, there is every probability of its escape in considerable quantity during the operation. Among other causes contra-indicating the operation, Beer mentions the existence of a very broad arcus senilis, which, he says, if divided, will not heal: other circumstances being favorable, however, this is no objection, as there is abundant evidence to show that a wound made here heals as elsewhere. But independently of these objections to the operation, connected with the patient, there is another, with reference to the operator; this operation is deemed to be one of the most difficult in surgery. No doubt much previous practice is required for its dexterous performance.

Secondly. In *depression* or *couching*, the cataract is displaced downwards, and is thus removed from the axis of vision, still, however, remaining in the eye.

Reclination is a modification of depression; the lens is not pushed downwards in a straight direction, but is turned on its axis, so as to lie horizontally in the vitreous humor; the anterior surface looking upwards, and the posterior downwards.

The operation of depression is adapted to cases of hard cataract, in which, for some of the reasons before mentioned, extraction is not applicable. Its advantages are, facility of performance, requiring no great amount of manual dexterity, the less amount of risk accompanying it, and power of repetition if previous attempts have failed. The disadvantages of the operation are, the liability to inflammation, from pressure of the displaced lens on the ciliary processes and retina, which is with difficulty subdued, on account of the cause of inflammation remaining behind. The lens may again rise to its position; this, however, seldom happens, if the removal has been sufficient. Unless extraction is contra-indicated, whether by the condition of the eye or the inexperience of the operator, it should be performed in preference to depression.

Thirdly. In the operation for causing *absorption*, the capsule of the lens is opened, and the substance of the lens, if necessary, divided, so that it may be exposed to the influence of the aqueous humor. The needle is introduced either through the sclerotica (posterior operation), or through the cornea (anterior operation). This latter proceeding is termed *keratonixis*.

Operation by *drilling*, is a modification that was practised by the late Mr. Tyrrel, by which a needle is passed through the cornea into the substance of the lens. The instrument is rotated and then withdrawn.

The operation for producing absorption is adapted to cases of fluid, or soft cataract, of a consistence not exceeding that of the natural lens; it is especially suited to congenital cataract. Its advantages are, facility of execution, and the little risk there is of producing inflammation. Its disadvantages are, the time required for the removal of the cataract; frequent repetition of the operation being required; the cure, in many cases, may be extended over weeks, or even months; the requisite time will be in proportion to the consistence of the lens, thence this method is very ill adapted to cases of hard or firm cataract. In such cases, in addition to the inconve-

nience resulting from the length of time required for absorption, there is a risk of the central harder portion becoming detached and dislocated, and of exciting dangerous inflammation after the softer portion has been absorbed.

Where the cataract is of such consistence as to require the capsule to be *freely* lacerated, or the lens, in addition, to be divided, the posterior operation is preferable. The anterior operation is generally practised in cases in which it is required simply to wound the capsule, being mostly adopted as the first step in the proceeding for producing absorption. Mr. Tyrrel's operation of drilling is adapted to cases of capsular or capsulo-lenticular cataract, with adhesion of the iris.

EXTRACTION.

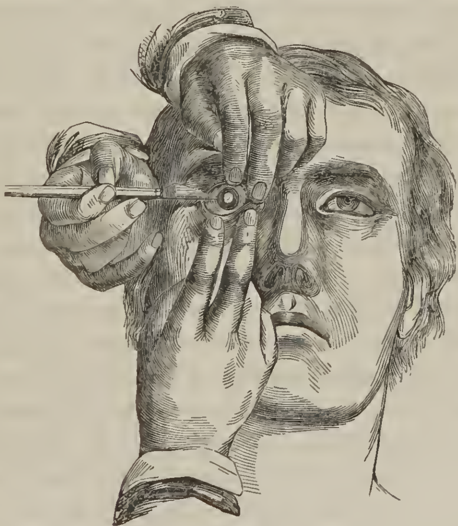
Before proceeding to the performance of this operation, the surgeon should take care that his instruments, &c., are properly arranged within reach, and that the assistant thoroughly understands the duties he is about to undertake. The patient is placed in a recumbent posture, on a couch of sufficient height to allow the head to be on a level with the lower part of the breast of the operator when seated; or on a table, with a pillow under the head, the operator standing upright; but, whether standing erect, or sitting, he should select a position which subjects him to the least possible degree of muscular exertion. A good light is of course necessary, but the direct rays of the sun should be avoided, and a northern aspect is preferable. The mode in which the light is allowed to fall upon the eye is a matter of no little importance; if it fall direct upon the cornea, as when the patient is opposite the window, its reflection from the eye greatly interferes with our view of the operation. The couch, &c., should be so arranged that the light falls obliquely on the cornea from above. The patient should be impressed with the necessity of exercising all the firmness in his power, and the great importance of his seconding the wishes of the surgeon. The other eye should be covered, so as to exclude the light, and prevent a view of what is passing. Supposing that the right eye is the subject of operation, the surgeon places himself at the head of the patient. The assistant depresses the lower lid, by placing the end of his forefinger on the integument below the ciliary margin, and draws it downwards, carefully avoiding all pressure on the globe. The upper lid is raised

and fixed by the surgeon in the following manner:—the point of his forefinger is applied to the centre of the margin of the lid, over the cilia, taking care to press them back smoothly against the skin. The lid is then drawn upwards towards the brow, the edge being carefully kept in contact with the globe, but all pressure avoided, and it is thus fixed against the upper margin of the orbit. The middle finger is then to be applied to the globe, near the inner canthus, and the lid in this manner secured. Then, by means of gentle pressure, the globe may be steadied. These preliminary arrangements may a little alarm the patient, and we should wait a moment or two before proceeding, in order that he may regain his self-possession.

The operation may be divided into three parts—division of the cornea; laceration of the capsule; removal of the lens.

Various instruments have been invented for making a section of the cornea, some very complicated, being far more ingenious than useful. Our object is to make a clean section of the cornea, of sufficient extent to allow of the escape of the lens, and I believe Beer's

Fig. 80.



knife to be the best yet invented. I prefer it, however, of a size somewhat below that used by Beer and others, which is both longer and wider at the base than is necessary. The first objection is the

more important, as the point is apt to come in contact with the inner canthus, before the section of the cornea is completed. The knife is held between the thumb and first two fingers of the right hand, like a pen; the two last fingers resting upon the temple of the patient, near to the outer canthus, in such a position that the point of the instrument can be carried to the nose by the action of the fingers, without altering the position of the hand. The cornea being previously touched once or twice with the flat part of the blade to prevent surprise, and as a warning that we are about to commence, the patient being at the same time cautioned against holding his breath, the point of the knife, with the edge directed upwards, is entered close to the margin of the cornea, in the line of its transverse axis, for the purpose of making an upper flap. This is accomplished by retracting the fingers, and directing the point somewhat perpendicularly to the surface; we thus at once enter the anterior chamber and avoid the error of passing the knife between the laminæ of the cornea, instead of completely transfixing the membrane.

As soon as the cornea is punctured, the handle of the knife is to be inclined downwards, so that the flat surface of the blade may be parallel to that of the iris, by which we avoid the risk of wounding this membrane. The surgeon, fixing his eye upon the point of the knife, carries it steadily across the anterior chamber, until it again penetrates the cornea at the inner extremity of its transverse diameter. The chief danger here to be guarded against is wounding the iris, or allowing that membrane to become entangled in the point of the knife, and this is best avoided by not allowing the point to dwell longer in the anterior chamber than is absolutely necessary. Up to this moment, the globe should be carefully steadied by the finger of the left hand, as there is an involuntary tendency to roll the eye inwards, and this should be counteracted by means of the extremity of the middle finger; but as soon as the cornea is transfixed on its nasal side, all pressure must be discontinued. It is, indeed, unnecessary, as the surgeon is now able to command the globe by means of the knife, and continued pressure may produce mischief, by occasioning the escape of the lens, and with it a greater or less quantity of the vitreous humor. It would be well now to pause for a few seconds, to allow any muscular spasm to subside. The point of the knife is then carried onwards towards the nose, till the section of the cornea is completed.

No attempt should be made to cut upwards, but the knife is simply to be pushed in the same direction onwards. Its form will ensure the completion of the section by this movement. If, however, we employ a knife of the ordinary length, its point sometimes arrives at the inner canthus, or nose, before it cuts its way out; it then becomes necessary, in order to avoid wounding these parts, to withdraw the blade, and again to propel it forwards, thus finishing the section by means of a sawing motion, on the completion of which the lids should be left free, and allowed to close. Before completing the cut, a second momentary pause is often advisable. Thus a flap is formed of the upper half of the cornea, concentric with its margin, and immediately within it. If this be accomplished in the manner above described, very little of the aqueous humor escapes, till the division is made.

The section of the cornea being accomplished, the chief difficulty of the operation is overcome, and the succeeding steps are comparatively easy. After a few moments' rest, the surgeon proceeds to lacerate the capsule with the sharp end of the curette. For this purpose he gently raises the upper lid, and introduces the instrument beneath the flap of the cornea, with the convexity forwards. When it has reached the pupil, the point is turned upon the capsule of the lens, and made to penetrate it, and then, by gently moving the instrument from side to side, the laceration is effected. This should be done pretty freely, that the lens may escape without much pressure; but the less it is disturbed the better. The instrument is then to be withdrawn with the convexity backwards; after a momentary pause, we remove the lens, the patient is directed to open the eye, and the surgeon, placing the small silver spoon at the other end of the curette, along the upper eyelid, at the same time applies his forefinger to the central part of the lower lid, and thus exerts a gentle and steady pressure upon the surface of the globe. To dislodge the lens requires sometimes rather firm pressure, which must be very carefully applied, until we see the edge of the lens rise in the pupil. The pressure employed should now become of the gentlest kind; the iris is distended, and appears as if about to be torn through, but it gradually yields, when healthy, and sufficiently so for the passage, even of the largest lens, which passes through it, and then escapes through the wound in the cornea. This part of the operation cannot be too cautiously performed. If firm pressure be persisted in, the hyaloid membrane may be lacerated, and the vitre-

ous humor escape. Immediately on the exit of the cataract, the upper lid is brought over the eye, and closed. The lids are allowed to remain together for some little time, and then carefully opened in order to ascertain that the pupil is round and clear, and the flap of the cornea in its position. This being effected, the sooner the eye is closed the better. When the lids are separated, the patient will sometimes discern the large objects around. No attempt whatever to use the organ should be allowed; no correct opinion can be formed as to the degree of sight likely to be regained, and such imprudent exposure is very likely to do mischief. The lids being carefully closed, so as to avoid disturbing the nice adjustment of the corneal flap, the patient is cautioned against moving them, and directed to keep as quiet as possible.

Supposing the left eye to be the subject of operation, the surgeon, if not ambidexter, must place himself in front of the patient, and will be compelled to trust the management of the upper lid to an assistant, who must elevate it, and render steady the globe, as previously directed to be done by the operator, who now takes charge of the lower lid. The assistant should keep his eye on the point of the knife, as it traverses the anterior chamber, and remove all pressure the instant it appears on the nasal side of the cornea. He is usually inclined to become absorbed in the proceedings of the surgeon, and forget the duties that devolve on himself. If the assistant is not fully to be depended on, he should be engaged simply to raise and fix the upper lid, and the surgeon himself must control the movements of the globe. Great advantages result from the operator being ambidexter, as he is then able to perform all the important duties of the operation on the left eye as well as on the right, by merely reversing the functions of each hand, and is thus rendered independent of the assistant.

There are many varieties in the method of operating for extraction of cataract. The one above described I believe, under ordinary circumstances, to be the most eligible.

Some surgeons of eminence perform the operation of extraction without an assistant. Mr. Alexander adopted this plan, and it is strongly recommended by Mr. Guthrie. The lids are separated, and the globe fixed by the fore and middle fingers of one hand. The advantage afforded by this plan is that the combined movements required in the execution of the operation are performed by one and

the same person. But when experience is wanting, it should not be attempted.

Some surgeons leave the opposite eye uncovered. In this case, we can direct the patient to look steadily at some object, with a view to bring the other eye into a convenient position for the operation. But I think it is better for the patient not to fix his eye on any given object. The previous employment of belladonna is sometimes recommended, to dilate the pupil. However, the instant the point of the knife enters the anterior chamber, the pupil contracts.

Some surgeons prefer operating on the patient in the sitting posture. A chair with a sliding back is very convenient in this case, as by its means the patient's head can be easily and firmly supported. If we have to use an ordinary chair, we may place a pillow over the back. The surgeon may either stand or sit; if he choose the latter position, his seat must be sufficiently high to enable him to operate without elevating his arms inconveniently. He may support his arm by resting the elbow on the knee, raised to a sufficient height by means of a stool. The operator, being behind the patient's head, must be sufficiently inclined backward, not by stretching the neck, but by sitting forward. If the surgeon be in front, he places his legs, one on each side of the patient. But operating on the patient in the recumbent posture is less irksome, and more comfortable for all parties, and requires the exercise of less control on the part of the patient.

The cornea may be divided in its lower, or in its lower and outer half. The lower section is most objectionable—the aqueous humor can more readily escape; there is more chance of prolapse of the iris, and the edge of the lower lid is very apt to interfere with the flap of the cornea.

Division of the cornea in its outer and lower portion is almost equally advantageous in all respects with the upper division. Moreover, as Mr. Tyrrel observes, if prolapse of the iris unfortunately occur to such an extent as to displace the pupil, it will be in a position more favorable to vision than in the case of the superior section. The advantages of the superior section of the cornea are thus enumerated by Mr. Lawrence: "The operator has a more complete control over the globe; he can fix it perfectly; the aqueous humor does not escape so readily, and the iris is consequently less likely to fall against the knife; there is less fear of prolapsus iridis;

and the pressure of the upper lid keeps the flap of the cornea in its right place."*

If the surgeon be not ambidexter, whichever section of the cornea is adopted, he will always stand behind when operating on the right eye, and in front when operating on the left. If, however, he can use the knife equally well in either hand, he can select his position. In the case of the lower, or lower and outer section, he may be placed either in front or behind; in the former position, he avoids the inconvenience of cutting from himself; in the latter, he gains a more complete control over the globe, and retains the management of the upper lid.

This operation is beset with difficulties, and it requires the exercise of some skill to avoid them; they meet us at every step.

The eye is sometimes so irritable that we are unable to select a favorable moment for commencing the section: this most frequently arises from mental influence, and is best overcome by diverting the patient's attention as much as possible from the operation; or we may direct him to fix his eye upon some object. This restless condition of the eye may, however, be common to it, and can then only be overcome by the pressure of the finger.

If we hold the knife too horizontally, in attempting to puncture the cornea, the point is very liable to pass obliquely into its substance, instead of through it. This accident is readily detected by the dull appearance of the portion of the blade between the laminæ, and by the resistance experienced to the advance of the knife: we should withdraw the point.

In making the section of the cornea, if we in the slightest degree retract the knife, or allow the globe to move from it, the aqueous humor escapes, and the iris approaches the cornea. A violent spasm of the muscles of the globe, caused by the introduction of the knife, will also sometimes force out a portion of the aqueous humor. Should this accident occur, as soon as the knife has entered the anterior chamber, and when the wound in the cornea is small, we should withdraw the knife immediately, and defer the operation till a subsequent period. If the knife have traversed the half, or even the whole of the anterior chamber, and the point become completely entangled in the iris, it is best to withdraw the instrument, to close the eye, and defer the operation. Should the knife, however, have

* Lawrence on Diseases of the Eye, page 622.

transfixed the cornea on its nasal side, before an accident occurs, and the margin of the iris then rise over the edge of the blade, we must pause for a moment or two, till the spasm of the muscles subsides, and then endeavor to press back the iris with the forefinger. If we succeed in this, we should slowly complete the section. As the knife advances, the broader portion occupies the anterior chamber, and thus the chance of the iris interfering with its edge is diminished. If we fail in our endeavor to disentangle the iris from the edge of the knife, we should withdraw it, and complete the section of the cornea with a small knife, blunt at the extremity, which is to be introduced through the aperture, and kept close to the posterior surface of the cornea, and the division completed by a gentle sawing motion, in the direction originally intended. Some complete the section of the cornea with Daviel's scissors; but the wound thus inflicted does not heal so readily as that made by the knife. A double-bladed knife has also been invented for this purpose, but is complicated and inconvenient.

If, before counter-puncturation is effected, the globe should roll upwards and inwards, to such an extent that the inner margin of the cornea is concealed from view, and if the patient be unable to turn the globe back again, it is better to withdraw the knife than to proceed at hazard.

If an assistant, having the command of the upper lid, allow it to slip during the passage of the knife across the anterior chamber, the instrument should also be withdrawn.

The section of the cornea may be too small to allow of the escape of the cataract, and this usually arises from bringing the point of the knife out at too great a distance from the inner edge of the cornea, or the section may not extend to half its circumference. The first defect can scarcely be remedied. In the second case, the incision may be extended by means of a narrow curved knife, blunt at the extremity: it is to be introduced into the anterior chamber, with the end close to the posterior surface of the cornea, and the edge directed against the extremity of the incision, which should be enlarged. The knife is alternately withdrawn and advanced, till the division is effected to the required extent, in a line immediately within, and as much as possible concentric with its margin.

The presence of adhesions of the pupil to the capsule of the lens is a reason against the operation for cataract. The existence may be discovered beforehand, if the eye be examined by means of bella-

donna. Should they exist at the time of operating, they will prevent the pupil dilating sufficiently for the escape of the lens. The cataract rises against the pupil, which does not dilate, except at a part of its circumference only, although the flap of the cornea is so raised that we at once see that its section is sufficiently capacious. If the adhesion be of small extent, the iris may be liberated by the sharp extremity of the curette; but if more extensive, it becomes necessary to enlarge the pupil, by dividing the iris; this is accomplished by Maunoir's scissors, which are to be introduced, closed, beneath the flap of the cornea, until they reach the margin of the iris, when the blades are to be separated, one being passed before, and the other behind the iris, to a distance proportioned to the extent to be divided.

The iris is sometimes wounded in making the section of the cornea, or a portion may be shaved off. This is not often followed by any unfavorable symptom; the pupil, of course, becomes extended and irregular. If the resulting aperture do not communicate with the pupil, the lens may rise against the new opening, and its escape be thus prevented. Under all circumstances, the two openings should be laid into one by means of Maunoir's scissors.

The capsule may not be sufficiently lacerated to allow of the escape of the lens. When pressure is made, the iris protrudes forwards, but the lens does not rise. The remedy is to re-introduce the sharp extremity of the curette, and lacerate the capsule a little more freely.

Sometimes the completion of the section of the cornea is immediately followed by the escape of the lens, with or without a greater or less portion of the vitreous humor. This occurs from undue pressure on the globe, either from its muscles, or the fingers of the operator. There is no doubt that a considerable portion of the vitreous humor may be lost, without interfering with the success of the operation: as much as a third part may escape without any very untoward result; but when the hyaloid membrane is once ruptured, the vitreous humor escapes upon the slightest pressure, and sometimes to such an extent as to destroy the eye.

Mr. Lawrence observes that the escape of a small quantity, in many instances, "seems rather to contribute to success; it lessens the bulk of the globe, and thus prevents the tension which occasionally succeeds to the operation. Sometimes there is a spasmodic action of the muscles, propelling the vitreous humor against the

cornea, and preventing the apposition of the flap. I have, in such cases, introduced the curette through the pupil, and let out some of the vitreous humor purposely."* Sometimes, however, the vitreous humor escapes instead of the cataract, rising from under the edge of the lens into the pupil. If we continue pressure on the globe in this case, we shall only increase the mischief. We must remove the lens by means of a slender hook, introduced into the anterior chamber, with the convexity towards the iris; the lens, being secured, must be withdrawn with the utmost care. A very unpleasant complication to deal with occasionally happens under these circumstances; the lens becomes dislocated behind the iris, either while using the curette to lacerate the capsule, or from pressure on the globe; in attempting to extract the lens, the hyaloid membrane gives way very readily under these circumstances. If the lens be still visible, it must be removed with the hook, as above described. It is very difficult to effect this without the escape of a considerable portion of the vitreous humor. Mr. Tyrrel describes some cases in which the extraction of a displaced lens by means of the hook was followed by hemorrhage from the central artery of the retina to such an extent as to destroy the eye. If the cataract be displaced to such a degree as to sink out of view, the surgeon will do well not to interfere with it any further; the patient may recover useful sight; the lens being removed from the axis of vision, and the operator, in attempting to remove it, might cause a loss of so large a quantity of the vitreous humor, or excite so much inflammation as to destroy the eye.

Sometimes it happens that the lens does not escape entire, but that portions of the softer circumference remain behind, so that the pupil is still not entirely clear. In this case, although the nucleus is firm, the exterior is generally much softer. The fragments may lodge either in the posterior or anterior chamber, or a portion of lenticular substance might occupy the pupil. If in the posterior chamber they must be allowed to remain, where they will readily be absorbed; their presence is not so likely to occasion inflammation as any attempts we may make to remove them, which would, moreover, in all probability, prove unsuccessful, or give rise to prolapse of the iris, or loss of a considerable portion of the vitreous humor. If, however, a detached portion of the lens pass into the anterior

* Lawrence on Diseases of the Eye, page 627.

chamber, or occupy the pupil, and can be removed easily, it may be done: fragments in contact with the anterior surface of the iris are very liable to cause irritation, or even inflammation. The silver spoon, or scoop of the curette is for the purpose of removing such portions; but the less this instrument is employed the better.

And for the same reason, should an opaque capsule remain after the extraction of the lens, no attempt should be made to remove it; the danger is here even greater than in the other case, and we should certainly not accomplish our purpose, without the escape of a dangerous quantity of the vitreous humor; moreover, the proceeding is unnecessary, for an opening in the capsule of sufficient size to allow of the escape of the lens will also be large enough for the purposes of vision.

The removal of the lens is sometimes followed by prolapse of the iris, which is forced through the opening in the cornea. Gentle friction on the upper lid, followed by a momentary exposure of the eye to the light, may first be tried; and if this fail, the prolapsed portion may be pushed back into the anterior chamber, with the small silver scoop; if, however, the prolapse recur immediately the instrument is withdrawn, it is well to wait for a few minutes in order that the spasmodic action of the muscles may subside, when the attempt may be repeated. Should this fail, it may be expedient to evacuate a small quantity of the vitreous humor, as it is very desirable to remedy this untoward occurrence. The sharp extremity of the curette is introduced in the manner before described, and the crystalline capsule very cautiously lacerated, and great care is necessary to prevent too much of the humor escaping, more especially as the pressure causing the prolapse of the iris will tend to force out the vitreous humor.

Sometimes escape of the vitreous humor is accompanied by protrusion of the hyaloid membrane, which projects through the wound of the cornea, as a fine vesicle. It may be mistaken for a portion of the vitreous fluid. It must be returned into the anterior chamber, with the blunt extremity of the curette; but if it again protrude, as soon as the support of the instrument is withdrawn, the prolapsed portion must be carefully removed with a fine pair of scissors. It will interfere, no doubt, with union of the cornea; but repeated attempts to remove or return it are extremely mischievous, and are generally futile.

AFTER-TREATMENT.

As soon as the operation is concluded, and the lids closed, they should be kept in that state by the application of a light bandage. The employment of any form of adhesive plaster for this purpose is extremely injurious, and should, most certainly, be avoided. The object is to cover the eye as lightly as possible, in order to keep it quiet, and guard it from any slight accident. A piece of soft linen rag, doubled, and moistened with cold water, should be laid over each eye, and secured by means of a strip of linen, in the following manner. If the patient wear a nightcap, it is to be drawn gently on the head, and the middle of the bandage secured to it behind, by a few stitches; each end is then brought round the corresponding side of the head, and across the rag covering the eye. The two ends, after crossing on the forehead, are pinned to the cap; the covering over the eye which has been operated on being first secured. If the patient do not wear a nightcap, this circular bandage may be fixed by means of an additional piece passing transversely over the summit of the head, and fastened to the former at the temples.

This application is preferable to that of passing the bandage round the forehead, and by thus supporting the rag, to allow it simply to hang over the eye.

The patient may remain undisturbed for a few minutes after the application of the bandage, or indeed for a much longer period, if his position be an easy one, otherwise he may be carefully removed to a couch or easy-chair; this is preferable to putting him at once to bed, for time passes more cheerfully, and he is less likely to sleep during the day, and consequently will rest better at night. The room should be kept cool and darkened. The patient should be cautioned not to talk, not to attempt to touch the eye or blow the nose, and to avoid coughing or sneezing, if possible. No food should be given requiring mastication. When placed in bed, his head and shoulders should be raised, and he may incline a little on the side opposite to the injured eye. An uneasy smarting or aching sensation is experienced in the eye for the first twenty-four hours, or more, after the operation, increased by any movement, and relieved by the escape of a little fluid, which from time to time flows from between the lids. The patient should be informed of this, but at the

same time directed to complain, if any increase of pain be felt, or if the above symptoms do not gradually subside. The bandage may be removed, and the lids cleansed from any mucous secretion, with tepid water, occasionally. This should be done in the gentlest manner, with the softest sponge. If the patient find it comfortable, the rag may be moistened before it is re-applied, but the repeated application of cold and moisture is dangerous. Some patients are in the habit of rubbing the eye, and to guard against this, especially during the night, it has been recommended to secure the hands with tapes: this is perhaps objectionable; but it is highly important to have an intelligent attendant, who will watch the patient during the night, as he is liable to become nervous and restless. This condition may be relieved by the exhibition of a narcotic. Some preparation of opium in a full dose is generally employed; I prefer the employment of henbane;—opium often affects the head, very objectionably, and its tendency to constipate the bowels is certainly no recommendation; the latter objection, however, may be avoided by the employment of morphia. The production of sleep by artificial means is not so much required as the removal of anxiety, restlessness, and nervousness. A full dose of henbane should be given, one to three drams of the tincture, or ten to fifteen grains of the extract dissolved in water, with or without the addition of a little sulphuric ether. The bowels, being cleared before the operation, need not be disturbed for twenty-four or thirty-six hours, when, if not relieved, a mild aperient may be given.

If all proceed favorably for four or five days, the eye being free from pain or uneasiness, and the upper eyelid neither red nor swollen, the prognosis will be favorable. At this time we may raise the upper eyelid, to ascertain the condition of parts beneath. If progressing favorably, the wound in the cornea will have completely healed, the globe is free from unnatural redness, numerous vessels, however, being visible in the conjunctiva and sclerotica, running towards the section of the cornea:—these are vessels of repair. The pupil is regular, and vision good. We must be careful not to expose the eye to the light for a longer period than is necessary to ascertain these points; the bandage may now be laid aside, and a common green shade substituted. The patient may be permitted to move about the room, moderately lighted, the eye being occasionally opened, and if no uneasiness result, for a longer period at each time. At the expiration of eight or ten days, he may use it more freely in

a weak light, the shade being first laid aside in the twilight. At the expiration of a month, he may be supplied with spectacles. The lens being removed, the refractive power of the eye is of course greatly diminished, and this loss must be compensated by the use of convex glasses. He should avoid exerting the eye too freely for some time to come, particularly in a strong light, and should take care not to expose himself to cold.

In the above description, it is presumed that all proceeds favorably; but, indeed, when we consider the amount of injury inflicted, and the delicate structures involved, the occurrence of inflammation ought not to surprise us. We should watch the patient very closely for the first forty-eight hours after the operation, and treat actively the first symptoms of inflammation. I cannot refrain from adverting to a practice which has been followed by several high authorities, believing it to be extremely injurious, and based on erroneous principles. I allude to the practice of bleeding the patient from the arm in the evening after the operation, *as a general rule.* If the slightest symptom of inflammation arise, this is undeniably the treatment to be adopted; but, independently of such indications, I protest against the practice. It is often alleged in its favor that it can do no harm. Facts, however, are opposed to this assertion—the abstraction of blood, under such circumstances, has often been followed by faintness and vomiting; in consequence of the straining induced by the act, the vitreous humor has been forced out in such a quantity as to destroy the eye. If the *state of the system* be such as to require this remedy, it must proceed from neglect on the part of the surgeon. Mere acceleration of pulse, the result of anxiety or nervousness, induced by the operation, is not to be subdued by depletion. Should, however, any symptom of acute inflammation present itself—and the most frequent indication is a darting pain in the globe; if there be pain in the eye or head, and the state of the pulse permit it, blood should be immediately taken from the arm. The patient should be raised in bed, and the quantity abstracted regulated by the symptoms. We should take away a sufficient quantity to remove the pain, or to produce a sensible effect on the pulse; avoiding syncope, for the reason before mentioned. Venesection must be repeated, if necessary: if inflammation be disposed to advance, the success of the operation becomes extremely doubtful. Local abstraction of blood, by cupping or leeches, is not so convenient in this case; it is necessary to disturb the patient to an

injurious extent. The other remedies for inflammation are also to be resorted to—such as abstinence, purgatives, &c. The use of mercury, so as to affect the system, by checking the adhesive process, will very probably prevent the union of the cornea, and had therefore better be avoided, if it can be dispensed with.

When symptoms of inflammation do not occur until thirty or forty hours after the operation, we must ascertain the nature of the inflammation before we proceed to treat it; the bandage must be removed, and the eye examined. If a sharp and severe pain occur; if the eyelids are swollen, and of a bright red color, and extremely tender to the touch; if a thick yellow secretion hang about the palpebral fissure and inner canthus, and if the conjunctiva be red and swollen, acute inflammation is present: inflammatory fever will in this case accompany it. We must lose no time in combating these symptoms with the most active measures. If, on the other hand, although the pain and suffering be equally severe, the palpebræ be swollen, and but little discolored and œdematous; if the secretion from beneath be thin, and of a pale yellow color, or white; if the conjunctiva be of a pale red color, and raised by œdema of the submucous tissue; if the cornea be hazy, and the section not adherent, we have a very different disease to deal with, the result of a want of power in the system. Inflammation of a more chronic kind is present, and is to be combated by very different means from those employed in the last case. Union of the wound has here failed from inability to carry on the process of repair. The pulse is feeble, although quick; the extremities are cold; the patient is restless, and complains of depression. Good nourishment in the liquid form must be exhibited freely, with stimuli and opiates. Wine, &c., must be given freely.

The two cases above described are totally different in their nature, and require the very opposite methods of treatment. The result depends upon a correct diagnosis.

Inflammation of the iris, with or without inflammation of the sclerotic coat, occasionally occurs after the operation. It usually commences about the fourth day, and presents the usual symptoms. It is treated in the ordinary manner, but mercury has not the same influence over the disease here, as with that arising from internal causes; and, moreover, its use is otherwise objectionable. Belladonna should be employed, and the iris retained constantly under its influence.

Prolapse of the iris is not a very uncommon occurrence within the first three or four days after the operation. It is generally occasioned by some sudden effort on the part of the patient, or it may arise independently of accidental causes, from internal changes, producing general fullness and distension of the eye. The protruded portion suffers from pressure, and irritates the mucous membrane of the lids. We must endeavor to bring the eye into a quiet state, and thus prevent farther mischief. We cannot in this case replace the prolapsed portion. The iris becomes adherent to the cicatrix of the cornea, and the pupil is more or less altered in shape and position. If this adhesion should not occur spontaneously, we may promote it by touching the prolapsed portion with a point of nitrate of silver, or apply a strong solution with a fine camel's hair pencil. The caustic, however, should not be unnecessarily employed.

DEPRESSION.

Various needles have been employed for this operation, but that invented by Scarpa, which is slightly curved at the extremity, is best adapted for the purpose. Before the operation, the pupil should be fully dilated by belladonna. It is desirable to operate on the patient in the sitting posture, as the surgeon can then more readily ascertain when the cataract is sufficiently depressed. The patient should be seated on a low chair, in such a position that the light falls obliquely on the eye; the surgeon being placed opposite to him on a higher seat. The head is either supported on a pillow, over the back of the chair, or against an assistant's breast, who fixes the upper lid. The surgeon depresses the lower lid, and steadies the globe with one hand, and supports the other by resting the two last fingers upon the malar bone. He then punctures the sclerotica about one line and a half behind its margin, on the temporal side, in the line of its transverse diameter. The needle should first be directed towards the centre of the globe, with its convexity to the iris, but as soon as it has penetrated the tunics, it is to be passed in the direction between the lens and iris, when it will become visible through the pupil, and is then to be carried to the upper and front part of the lens, the concavity of the curve pressing upon it, when depression is to commence. The cataract is to be steadily and gradually pressed by the needle downwards and backwards from the axis of vision. This being accomplished, the needle having been kept for a moment or

two on the lens, it is to be disengaged by gentle rotation; the blade is then raised opposite the pupil, in order to see that it is quite free, and also for the purpose of ascertaining that the lens is fixed in its new position; if so, the needle is to be withdrawn. Should the lens, however, rise when the needle is lifted from it, it must be again depressed by the instrument.

RECLINATION.

The needle is to be introduced in the same manner; as soon as it becomes visible through the pupil, it is brought against the capsule a little above the centre. By gradually and steadily pressing the needle backwards, the lens will be reclined; the upper edge passing backwards, and the anterior surface becoming superior. The instrument should be liberated by rotating it, and then again fixed near the centre of the lens, which is now to be carried below the axis of vision by gentle pressure downwards. If the lens lie so far forward that its inferior edge press against the iris or ciliary processes, it should be moved a little backward. The needle being then disengaged, is brought to the pupil, and, if the cataract remain depressed, is to be carefully withdrawn; but if the cataract rise again, the same process must be repeated.

The principal considerations are, to avoid injuring the iris, or ciliary processes, either by the needle, or by pressure of the lens. The lens is sometimes carried a little backwards, in order to avoid this, and also for the purpose of getting its edge under a portion of the vitreous humor, to prevent it rising; but the danger of pressure upon the retina must be carefully avoided.

After-treatment.—The consequences of this operation are more severe than may at first be imagined; a punctured wound through all the tunics; the lens forcibly dislocated; its capsule torn, and the hyaloid membrane lacerated. We shall not, therefore, be surprised at the occurrence of inflammation, which is as common as after the operation for extraction. The same precautions must be employed as in the after-treatment of that operation, and the patient as closely watched. Inflammation of the retina or iris, occurring in this case, is very often fatal to vision; for, inasmuch as the exciting cause is still in operation, the most vigorous measures are very likely to fail in subduing the mischief. Inflammation of the iris, if proceeding from injury by the needle, is more amenable

to treatment, and generally yields to depletion and the influence of mercury.

After some time, the lens may again rise into the axis of vision; if this occur, which I believe is seldom, the operation may be repeated. The hard nucleus of the lens may escape from its resting place, and pass into the anterior chamber, exciting violent inflammation, which is scarcely influenced by treatment, while the cause continues to act. We must remove this by extraction; the operation, of course, is performed under the most unfavorable circumstances, but we have no alternative.

ABSORPTION.

Posterior Operation.—The pupil should be previously fully dilated by belladonna. The instrument employed for this operation is a straight lance-shaped needle, with the edges sharp from the point backward to a little beyond the shoulder. The best form I have seen is that employed by Mr. Dalrymple. The position of the patient and surgeon is the same as in the operation of depression, unless the surgeon prefer to be behind the patient. The sclerotica is punctured at the same point as in the previous operation, and the needle is carried on into the posterior chamber, the sharp edge is turned upon the capsule, and by retracting the needle, it is made to divide it. If the cataract be fluid, the contents will escape into the chambers of the eye, and render the aqueous humor turbid; but if it be merely soft, and not fluid, we gently move the needle through it once or twice after dividing the capsule; the needle is then withdrawn. After the lapse of a week or two, we may repeat the operation, dividing the substance of the lens more freely, and at length proceed to break up what remains into fragments, passing them into the anterior chamber. This part of the operation should be carefully executed, because pieces of the cataract in the anterior chamber act as foreign bodies, and may excite so much inflammation as to render their extraction necessary. This is more especially the case in the firmer varieties of cataract; a small particle may create much disturbance, while a larger portion of the soft or gelatinous kind may be passed into the chamber with impunity. In the performance of this operation we must take care not to dislocate the lens, and we should also be cautious to avoid attempting too much, particularly in the first operation. Inflammation is very likely to follow an

operation where the needle has been used too freely, from a desire on the part of the surgeon to expedite the cure. The eye should be covered in the same manner as after the operation of extraction. It may be cleansed with tepid water occasionally, twice or thrice in the twenty-four hours. Belladonna should be applied to the brow, and means employed to avert inflammation.

Anterior Operation.—It is very important that the pupil be previously fully dilated. The patient may be placed either in the recumbent or sitting posture. A straight needle is the best instrument to employ, and we should take care that it is so shaped as to fill up the wound in the cornea, and thus prevent the escape of the aqueous humor. The needle being held as in the operation of depression, is introduced through the cornea on the temporal side, about midway between its centre and margin, the flat surface being opposed to the iris. It is carried through the pupil and made to puncture the capsule a little above the centre; then being directed downwards, the capsule is divided; this should be done with as little disturbance to the lens as possible, and immediately it is effected the needle should be withdrawn.

The after-treatment is the same as in the posterior operation. A curious circumstance is sometimes observed after this operation, more especially if the cataract be fluid, or if a considerable quantity of aqueous humor escape during its performance. The stomach becomes very irritable, and vomiting ensues; this is sometimes very violent. I think the best remedy will be found to be a few drops of dilute hydrocyanic acid, in a tablespoonful of cold water.

OPERATION OF DRILLING.

The patient is placed as in the anterior operation for absorption. A very fine straight needle, of uniform thickness, is passed rather obliquely through the cornea, at the outer part, the point being directed against the capsule, close to the inner margin of the pupil. The lens is penetrated to the extent of about the sixteenth of an inch, and the handle of the instrument rotated between the forefinger and thumb, so as to make the needle act as a drill, which is then withdrawn. The operation is to be repeated every two, three, or four weeks, according to the degree of absorption, care being taken to puncture the opaque capsule at a different spot in each operation. This operation usually requires to be repeated seven or eight times.

If proper caution be employed, there is very little risk of subsequent inflammation. If there be considerable contraction of the pupil, it may be necessary, after absorption of the lens, to make an artificial one.

We may, in some cases, employ a combination of two operations in the treatment of cataract, with advantage. I have already alluded to the plan of performing keratonixis, as the first operation for producing absorption, and subsequently completing the cure by the posterior operation. We occasionally meet with cases in which the only objection to the operation of extraction is the small size of the anterior chamber, in consequence of projection of the iris, induced apparently by the large size of the cataract. In such cases the anterior operation for absorption may be performed, making a very small opening in the capsule, and when the lens is sufficiently reduced in size it may be extracted; for, although the nucleus is hard in almost every instance, the exterior of the cataract is sufficiently soft for absorption. We must remember, however, that the capsule has been already wounded, and exercise due caution to avoid pressure on the globe. In the same manner, if circumstances forbid the operation of extraction, that for absorption may be performed previous to depressing the cataract; and I think the combination of two operations to be more advantageous in this case than in the former, for, if we have a cataract with a firm centre to deal with, and cannot extract it, we may render depression much less objectionable by previously reducing its bulk. True is it that hard cataracts are generally diminished in size, but exceptions to this rule occasionally occur; at any rate, I think there are cases in which this mode may be advantageously adopted.

OPERATION FOR OPAQUE CAPSULE.

It sometimes happens, after an operation for cataract, that an opaque capsule remains behind, obstructing vision, or the capsule may become opaque after the operation, either immediately, in consequence of inflammation of the iris, or at the expiration of some months, or even years. The opaque capsule varies in appearance and texture: it very frequently becomes thickened and tough, or it may be thin and semi-transparent; it may either be a continuous membrane or perforated in several places, or consist merely of one or more bands; or portions of opaque membrane, free at one ex-

tremity, may float before the pupil; and, lastly, the opaque capsule may be adherent to the iris. Vision may be restored by one of the following operations; the iris being fully dilated by belladonna, which should also have been previously employed in making a minute examination of the eye. (1.) If it be in the form of shreds or bands stretching across the pupil, these may be divided by a needle introduced through the sclerotica. (2.) If the opaque capsule exhibit a delicate structure, the surgeon may either make a central opening in it, by means of a needle introduced through the cornea or sclerotica, or divide it transversely or crucially, the instrument being passed through the sclerotica, care being taken not to detach it at the circumference. (3.) When the capsule is so thick and tough that it cannot be divided without great difficulty, we may detach it at its circumference, on the upper part and sides, and depress it: at first it rises again, but soon begins to shrink, gradually disappearing below the pupil. This, however, does not always occur, and it is very often an unsatisfactory operation. A better mode is to twist the membrane; and this is accomplished by means of a curved needle introduced through the sclerotica. The point of the instrument is made to pierce the capsule from behind, near its outer side, and again from before near its inner side; the needle being then rotated, the capsule is twisted around it, and detached from its connection. It is removed from the axis of vision as the needle is withdrawn from the eye. This method of operating may be adopted in those cases in which the capsule is adherent to the iris. We must here, however, proceed with additional caution, lest we tear the iris, or detach its circumference. (4.) The greatest difficulty is experienced in the treatment of those cases in which the opaque capsule is loose and floating. If we can pierce and twist it around the needle, we may withdraw it from the axis of vision. The attempt to extract a portion of capsule through an opening in the cornea is very hazardous. Its removal may be much more readily accomplished through the sclerotica by means of an elegant little instrument invented for that purpose.

OPERATION ON INFANTS.

Congenital cataract, although very often lenticular, at first speedily becomes capsulo-lenticular, and the lens frequently undergoes absorption, occasionally disappearing entirely in the course of time. As

the lens is removed, the layers of the capsule approach each other. In congenital cataract, the consistence of the lens is soft, sometimes fluid, and rarely beyond its natural consistence. Occasionally, the opacity is partial and confined to the centre.

The operation best adapted to cases of congenital cataract is division by means of the needle, which answers perfectly well. Extraction, for various reasons, is inadmissible. There is great danger in delaying the operation. In children born blind, the eyes oscillate from side to side, and the child becomes unable to control this action of the muscles. From want of vision, the power of directing the eye is not acquired; and although sight may be restored, the child remains unable to control the irregular movements of the globe for a period of years; indeed, some cases are recorded which tend to show that this difficulty is never completely overcome. The operation, therefore, should be performed not later than two or three months after birth.

The child should be laid on a table with the head inclining a little over a small pillow; the surgeon should secure the upper lid by means of a wire speculum; the lower being depressed by an assistant, who also supports the chin. The needle is to be introduced through the sclerotica, and the lens and capsule freely divided by alternately advancing and retracting the needle; when broken up, the fragments may be pushed into the anterior chamber. Both eyes may be operated on at the same time.

It may be necessary to repeat the operation, perhaps even more than once, before the pupil is quite clear: this, however, should not be attempted at too short an interval. The operation, if carefully performed, is rarely followed in infants, or indeed in young persons generally, by inflammation. The eyes should be covered for some time after the operation, if this can be conveniently managed; otherwise, the infant must be kept in a dark room. The state of the bowels should be attended to, and belladonna applied both before and after the operation.

Wounds of the lens and capsule are followed by opacity of these parts, and the same effect is occasionally produced by violence to the globe, without breach of texture; in this case, however, it is generally combined with amaurosis. In some examples of severe injury to the eye, the entire lens or large portions of it have become dislocated. They should be immediately extracted; in order to avert dangerous

inflammation, this should be done, even if sight be destroyed from injury to the other parts.

Cataract, the result of a wound of the lens or its capsule, in most cases gradually disappears, and the observation of this fact gave origin to the operation for absorption, which in this form is to be preferred, if the cataract threaten to become permanent.

CATARACT GLASSES.

Although after a successful operation vision may be tolerably good for large objects at some distance, still the use of convex glasses is necessary, in order to render it perfectly distinct. Some time should elapse before glasses are used, and they should at first only be employed occasionally; indeed, patients will do well to avoid much exertion of the eye at any time. Two pairs of glasses will be required, of different degrees of convexity, one for ordinary vision, and the other for accurate and near sight, such as for reading, writing, &c. The patient must select such glasses as will enable him to see objects distinctly, without magnifying them.

A curious little parasite (cysticercus cellulosæ) has been found inhabiting the anterior chamber of the eye. I believe four such cases have been published. Should our treatment be required, we should extract the little hydatid, making a section of the cornea, and removing it with a delicate hook. Other parasites have been found in various parts, such as species of filaria in the lens, and conjunctival cellular tissue.

CHAPTER XXVIII.

OPERATIONS ON THE ORBIT AND LACHRYMAL APPARATUS.

EXTIRPATION OF THE GLOBE.—EXTIRPATION OF TUMORS IN THE ORBIT.—STRABISMUS, OPERATION FOR.—OPERATIONS ON THE LACHRYMAL APPARATUS.—LACHRYMAL GLAND, EXTIRPATION OF.

EXTIRPATION OF THE GLOBE.

THIS is an operation sometimes performed on account of malignant disease, of which the globe is the seat. The result is seldom very satisfactory. The size and appearance of the globe are altered at the time of operating, the natural structures being more or less destroyed. A tumor of the fungoid or melanotic character projects from between the eyelids to a greater or less extent, while the lids and surrounding parts are swollen and of a dusky red color.

Our object in this operation is to remove the entire contents of the orbit. The patient lies on a table, with the head a little elevated by pillows. In these cases, chloroform is previously administered. The surgeon commences by passing a stout double ligature through the anterior portion of the mass, and forming a loop, which he holds for the purpose of moving the globe in any direction during the operation. An incision is made from the external commissure of the lids, transversely outwards on the temple, to an extent depending on the size of the tumor, perhaps from one inch to an inch and a half; this is always necessary, in order that the lids may be freely reflected from the tumor. The globe being then drawn upwards, and the lower lid in the opposite direction, the conjunctiva is freely divided at the line of its reflection, from one angle to the other, and continuing the dissection backwards, the origin of the inferior oblique muscle, and all other structures, from the floor of the orbit are to be divided, applying the scalpel close to the bone. The globe being now drawn downwards, the contents of the orbit are to be insulated throughout. The bone is greatly reduced in thickness in conse-

quence of absorption from pressure; and the knife, if carelessly used, may easily penetrate it. A long, narrow, sharp-pointed bistoury, curved laterally at the extremity, is now introduced at the outer side of the orbit, passed backwards, and the optic nerve and parts around divided. The ophthalmic artery usually bleeds freely for some little time after its division; but unless the orbit be plugged with lint the hemorrhage seldom continues. When the flow of blood has nearly ceased, we carefully examine the orbit, and especially so the divided extremity of the optic nerve. The incision extending from the commissure of the lids is to be accurately united by one or two sutures, and a soft rag, wetted with cold water, laid over the lids, and renewed as soon as it becomes warm and dry. The patient must be kept very quiet, and restricted to a spare diet. If inflammation arise, there is great risk of its extending to the membranes of the brain. In a short time, granulations spring up, and the cavity becomes filled to a certain extent; the eyelids sink inwards. The practice of filling the orbit, after the removal of its contents, with charpie, or sponge, or lint, is sometimes adopted, more especially on the Continent, for what good purpose I know not; there is no doubt that it is a highly dangerous proceeding, particularly adapted to produce evil results.

EXTIRPATION OF TUMORS IN THE ORBIT.

The cellular tissue of the orbit is sometimes the seat of tumors, either solid, or consisting of one or more cysts, with various contents. These tumors are rarely malignant. As they enlarge, the globe is pushed forwards, and otherwise more or less displaced, the optic nerve is stretched, and vision gradually destroyed. As the tumor increases in size, it comes forward at some part between the globe and the orbit, and becomes perceptible to the touch and sight. If not interfered with, the eyeball at length becomes completely thrust out of its socket; the upper wall of the orbit may become absorbed, and the brain affected.

No definite rules can be laid down for the removal of these tumors; the possibility of safe extirpation will greatly depend on their situation and connections. The place, direction, and extent of the external incision will be regulated by the circumstances of the case; it should be ample, in order to facilitate the subsequent dissection; the skin, if possible, should be divided in the direction of the mus-

cular fibres beneath. The tumor, being exposed, must be separated from the surrounding parts by a very cautious dissection.

The operation being concluded, the parts should be carefully cleansed with a soft sponge, and wet lint applied till all hemorrhage has ceased, when the edges of the wound are to be adjusted.

Aneurism by anastomosis has occurred in the orbit. Extirpation is impossible. Ligature of the carotid artery, however, has been practised with success, as in the well-known case of Mr. Travers.

OPERATION FOR STRABISMUS.

Strabismus, or squinting, may be convergent or divergent; the former is by far the more common. Some cases of convergent strabismus are greatly benefited by division of the internal rectus muscle. This operation, when first introduced, was resorted to with unwarrantable frequency, and, I believe, the same charge may even now be justly made. Squinting is a personal deformity, and therefore most persons will eagerly submit to any treatment that promises a cure. But this operation is attended with benefit in certain cases only, and much evil results if it be unadvisedly performed. Every case demands a specific examination, and the operation for strabismus is rather the exception than the rule of treatment. If strabismus can be remedied by any other means, we must discard all thought of operation, the performance of which is almost always followed by more or less of deformity. The eye appears unnaturally prominent, and gives a vacant expression to the countenance; but more untoward results than this have followed the operation in some instances; such as acute inflammation. If the affection be dependent upon any cause still in operation, that cause must, if possible, be removed; such as derangements of the sensorium and digestive organs, intestinal worms, &c.; it may possibly form but a part of some more general disease, such as infantile convulsions, chorea, &c.; or may arise "spontaneously," as it has been termed; a convenient expression of our ignorance of the exciting cause.

Strabismus may result from corneal opacity, or alteration in the position of the pupil; the direction of the eye is thus altered in order to render it available for vision; the affection may be occasional or temporary only; in none of them should the operation be undertaken. Under any circumstances, if of recent occurrence, we may endeavor to correct deformity by milder means; a black mark

may be made on the outer side of the cheek, as an object to which the eye may be directed, or the faulty eye may be employed exclusively for the purposes of vision, for one or two hours each day, the other being covered; the eye assumes its right position when thus used to the exclusion of the other; but there is some danger in this case of the sound eye becoming affected.

The operation is applicable only to cases of confirmed strabismus. Doubts have arisen as to the propriety of performing the operation, if the eye cannot be turned outwards, when the other is closed. Its success will not be so complete in this case; but it is generally attended with sufficient benefit to justify its performance. Occasionally, both eyes are affected; but in these cases of "double convergent strabismus," one eye is usually worse than the other; if we operate on this, the other very frequently assumes its right position. I have never felt warranted in operating on both eyes.

The operation of dividing the internal rectus muscle is thus performed. The opposite eye being bandaged, the patient is seated on a chair before a window, his head being supported against the breast of an assistant, who stands behind, and freely separates the lids by means of wire specula, applied immediately external to the cilia. The patient being directed to evert the eye as much as possible, the surgeon raises a fold of the conjunctiva with a pair of forceps, about a quarter of an inch on the inner side of the cornea, and divides it vertically to the extent of about three or four lines, with a pair of straight, blunt-ended scissors, then by cutting through the cellular tissue, the insertion of the rectus muscle into the sclerotica, about two lines from the inner margin of the cornea, is exposed. The surgeon now exchanges the forceps for a delicate hook, not quite sharp at the point, bent at about a quarter of an inch from the extremity, and flattened at the sides; this he inserts beneath the lower margin of the tendon, and passes gently upwards, till it appears above it, taking great care not to pierce the tendon, but to insulate it from the surrounding parts; this being accomplished, the surgeon completely divides it with the scissors, close to its insertion.

If the operation has been efficiently performed, and the internal rectus muscle completely divided, the patient will be unable to invert the eye considerably, a slight degree of inward movement being accomplished by the upper and lower recti muscles, owing to the peculiarity of their insertion. If the patient can still invert the eye

to any extent, the surgeon must search for any fibres which may still remain undivided.

If a bandage be applied over the sound organ, the patient is generally able to evert the affected eye sufficiently to enable the surgeon to operate with ease. Should he not be able to do this, however, the eye may be drawn outwards by means of a fine double hook, inserted into the sclerotica, internal to the cornea. I prefer dispensing with this proceeding, if possible. We are sometimes directed to insert the hook into the conjunctiva only; the fact is, whenever it is used, it is made to penetrate the sclerotica; and we should bear in mind that the greater the distance from the cornea, the thicker is this tunic. The points of the hook should be considerably separated. Some operators pass a grooved hook under the tendon, and divide it with a small curved knife. Others, again, dispense with the use of the hook altogether. The employment of the hook, I conceive, greatly facilitates complete division, the accomplishment of which without it is very uncertain. It is very unimportant whether the lids be separated by the wire specula, or by the fingers of the assistant.

OPERATIONS ON THE LACHRYMAL APPARATUS.

Extirpation of the Lachrymal Gland.—This gland occasionally becomes enlarged and indurated, exerting pressure upon, and displacing, the globe, and forming a tumor immediately beneath the outer part of the orbit. This state of the gland has often been described as scirrhus; but true scirrhus of the lachrymal gland is extremely rare. Tumors sometimes form in its immediate neighborhood, and have often been mistaken for disease of the gland itself, which, indeed, in some cases, has been removed under this impression.

We make an incision of sufficient extent over the tumor, parallel to, and immediately beneath the margin of the orbit: we dissect carefully around the disease. The tumor being insulated, we draw it forwards, and detach it at its base. When all hemorrhage has ceased, we close the edges accurately by means of fine sutures.

The *caruncula lachrymalis* sometimes becomes gradually enlarged, (encanthis,) with or without the semilunar fold being affected. It appears in the form of a red tuberculated tumor. This must be reduced by the application of caustic and other remedies. The re-

moval of a portion by means of the knife should only be practiced as a very last resource, the subsequent result of the operation generally being such a diminution of the natural size of the caruncule that it becomes unable to fulfil its office of supporting the inner junction of the tarsi; the consequence of which is that the puncta become displaced, and the tears escape over the cheek.

Polypous and fungous excrescences occasionally spring from the lachrymal caruncule, or semilunar fold, as well as from other parts of the conjunctiva. They may be excised, the caruncule being left untouched.

These parts are sometimes implicated in malignant disease.

The anatomy of the canalicules, lachrymal sac, and nasal duct should be well understood, before any attempt to interfere with these parts is made upon the living subject, their course and direction accurately ascertained, and the introduction of instruments frequently practiced on the dead subject. It is for the removal of obstruction in these parts that instruments are introduced; such obstructions are usually the result of chronic inflammation; but, before we attempt to overcome them by mechanical force, we must give a full trial to milder agents. These, if judiciously employed, will often succeed. But when these and other means fail to remove the obstruction, and it becomes permanent, we must restore the passages by mechanical dilatation. The tears being prevented from pursuing their natural course escape over the cheek, and the symptoms altogether become so urgent that some relief is absolutely required. When inflammation of the lachrymal sac proceeds to suppuration, and the integument over the soft tumor threatens to ulcerate, we open the sac, and allow the contents to escape. But suppuration sometimes takes place in the cellular tissue, external to the sac; when this occurs, the matter should be evacuated much earlier.

If the canalicules be obstructed, dilatation may be attempted by means of fine gold probes, introduced at the orifices; but the practice of introducing instruments through the puncta, whether for the purpose of exploring the passage or removing the obstruction lower down, is useless and injurious. Injection of the lachrymal passage with various fluids, by means of a syringe, with a delicate tube, introduced through one of the puncta, has been attempted. Such instruments were invented by Anel. The endeavor has been made to force a passage by the injection of mercury, but it is useless. If the parts be previously dried, any fluid dropped into the

lacus lachrymalis will be taken up by the puncta and pass down to the obstruction. The passage of the probe may be obstructed, by its extremity being entangled in some natural fold of mucous membrane; moreover, a canal large enough to admit such delicate instruments as we must necessarily employ to pass through, might still be too small to allow of the passage of the tears; how much less, then, can we expect such instruments to produce dilatation! When the obstruction is seated in the canalicules themselves, we may attempt to dilate them by their introduction; but contraction of the canal beyond them must be dealt with more practically.

The lower canalicule is exposed by the edge of the lower eyelid being held near the inner angle, and by slightly everting which, the punctum is brought into view; the probe is introduced with a rotatory movement, and is passed downwards and a little outwards, and then inwards.

The upper canalicule is explored with more difficulty. The upper eyelid is held and everted in the same manner, and the probe introduced with the same rotatory movement, first pushed upwards and then inwards and downwards. If we wish to explore the lachrymal sac through the puncta, it is best to introduce the instrument through the upper one.

We may explore the nasal duct by means of a probe introduced through its inferior aperture: this is by no means easily accomplished, and its ready performance requires much previous practice. We must remember that the nasal duct opens below, in the inferior meatus of the nose; that the orifice, which is an oblique fissure, directed downwards and inwards, is situated in the front and upper part of the lateral wall. The probe should be bent, but not abruptly, at about an angle of 60°, at the distance of somewhat less than an inch from the point. There should also be a slight lateral bend lower down, to allow for the projection of the nasal process of the maxillary bone.

But the common operation on these parts is the removal of obstructions, by the introduction of instruments, through an opening made in the lachrymal sac, immediately below the tendon of the orbicularis muscle. The operation is thus performed. The surgeon, drawing the lids outwards, renders tense and prominent the tendo-oculi; this is his guide: he introduces the point of a small double-edged scalpel, immediately below it, in a direction backwards, and a

little inwards; one edge of the blade looking outwards and somewhat downwards. The knife having been made to penetrate the sac, which is known by the cessation of resistance, the point is directed downwards, a little way towards the nasal duct. The sac being thus

Fig. 81.

freely opened, the knife is laid aside. If a fistulous opening into the sac previously existed, it may be enlarged in the same manner. A common sized probe, without a bulbed extremity, is now introduced; it is first passed in the same direction as the knife, until it strikes against the opposite wall, it is then slightly withdrawn, and directed in the course of the duct. Any reasonable obstruction must be overcome by careful and gradually increasing pressure, a slight rotatory motion being given to the instrument. The probe is known to have passed into the nose by the appearance of a drop or two of blood when the handkerchief is applied. The resistance to the passage of the probe may be so great as to render it advisable to desist, and repeat the attempt in a day or two.

Although the obstruction is thus for the present removed, it would soon recur, unless some means be taken to prevent it; this is accomplished by the introduction of a style or tube, one or other of which is to be constantly worn by the patient. If any unusual amount of irritation exist, it may be allowed to subside before one or other of these instruments is introduced.

When the style is introduced, the head, resting on the integuments, secures the style from sinking into the canal, and by closing the aperture, prevents the escape of fluid from the sac. The duct becomes dilated, and the tears escape readily by the side of the style into the nose. When the tube is employed, it is passed completely into the nasal duct, by means of a stylet contrived for that purpose, the rim at the top resting on the upper margin of the duct, and the integuments are allowed to heal over it. The advantage of the tube is that it gives rise to no deformity. Sometimes, however, when there has been much ulceration and thickening, the integuments will not close over it. It is very liable to be clogged up; it is apt to become displaced, and give rise to pain or inflammation, rendering its removal necessary; it cannot be extracted without an operation. A silver tube, moreover, is liable to be acted on by the secretions.

The head of the style produces but little deformity; it is either painted black, or of a flesh color; the style can be removed easily at any time without pain, and cleansed, and the passages, if necessary, may be cleared by gently injecting a little tepid water. Dr. Mackenzie* thinks it may fairly be doubted whether the tears actually flow through the tube, or descend merely on the outside, as they do along the surface of the style; and he thinks that a gold style, with a head to support it, passed completely into the sac, might be worn for life, and answer the purpose just as well or better than a tube. I am inclined to agree with Dr. M. At any rate, I generally prefer the style to the tube.

The os unguis has been perforated in some cases of complete obliteration of the nasal duct. I have never performed this operation, and have never seen a case requiring it.

* Mackenzie on Diseases of the Eye. Second edition, page 274.

INDEX

TO

INSTRUMENTS AND APPARATUS REQUIRED FOR SPECIAL OPERATIONS.

WOUNDS IN GENERAL.

Pocket Case, containing scalpel, director, probe, forceps, scissors, tenaculum, Assalini's forceps.

Lint. — Ligature silk of two sizes. — Needles. — Adhesive plaster. — Sponge.

DISLOCATIONS.

DISLOCATIONS IN GENERAL.

Ample quantity of strong cord, wash-leather, or linen washed with caoutchouc, to encircle the limb. — Pulleys. —Two staples. —Two or more rollers.—Cotton wool.—Lint.—Chloroform.

DISLOCATION OF HUMERUS.

Failing the heel in the axilla, the metal knob, represented at page 93. Humerus and scapula.

DISLOCATION OF FEMUR.

Round towel, or leather loop for counter-extension.—Bony pelvis and femur.

FRACTURES.

Ample quantity of tow, horse-hair, or cotton wool for pads.—Pads, large and thick, especially at the edges.—Linen for bandage. — Splints, two, three, or four, of wood or metal.— Straps, or linen rollers. — Leg-box, or cradle for lower extremity. — Scissors.

COMPOUND FRACTURE.

Interrupted splint. — Scalpels. — Forceps.— Needles.—Silk. — Sponge.— Adhesive plaster.—Pocket case.

ANEURISM.

Case of scalpels. — Retractors. — Director. — Probe.—Two pairs of forceps, fine and blunt-pointed.—Assalini's forceps.—Ligature silk, thick and waxed for large vessels, and fine for lesser.—Two or three varieties of ligature needles. —Tourniquet. — Scissors.—Half a dozen silk threads for tying wounded arteries, each from ten to twelve inches in length. — Two armed needles for sutures. — Two rollers. — Adhesive plaster. — Four sponges. — Lint. — Chloroform.

NÆVI MATERNI.

Strong nitric acid. — Glass rod.—Potassa fusa, acetic acid. — Three armed needles for sutures.—Lint.— Sponge.

VARICOSE VEINS.

CURE BY CAUSTIC.

Half an ounce of powdered potash and quicklime, in separate stoppered bottles.—Spirits of wine, in a third bottle.—A large piece of freshly-made adhesive plaster.—Lint.—Sponge.—Rollers.

AMPUTATIONS.

AMPUTATIONS IN GENERAL.

Amputating knife, see page 345.—Catlin.—Saw.—Bone forceps.—Two pairs of forceps.—Assalini's forceps.—Tenaculum.—Tourniquet.—Director.—Razor.—Scissors.—Calico or linen for retractor.—Twelve ligatures, from ten to twelve inches in length.—Four armed needles.—Adhesive plaster.—Cotton wool.—Two rollers.—Oiled silk.—Four sponges.—Chloroform.

FLAP OPERATION.

A long straight-pointed knife.—Eighteen ligatures.—Eight armed needles for sutures.

HAND OR FOOT.

Two strongly-made scalpels.—Metacarpal saw.—Bone forceps.

PHALANGES.

Fine scalpels.—Bone forceps.

EXCISIONS.

EXCISION OF HEAD OF THIGH-BONE.

Case of scalpels.—Two pairs of forceps.—Bone forceps.—Flexible spatula.—Various saws.—Ligature silk.—Six armed needles.—Four sponges.—Lint.—Adhesive plaster.—Pocket case.—Chloroform.

EXCISION OF ELBOW JOINT.

The same.

EXCISION OF CARPAL END OF RADIUS AND ULNA.

Small flexible spatula.—Fine saw, made to unscrew from the back.—Chain saw.—Splint.—Pad.

EXCISION OF ANKLE JOINT.

The same.

EXCISION OF UPPER JAW.

Case of scalpels.—Curved bladed knife.—Two pairs of bone forceps.—Two pairs of forceps.—Director.—Spatula.—Lint.—Silk.—Six armed needles.—Four sponges.—Adhesive plaster.—Pocket case.—Chloroform.

EXCISION OF LOWER JAW.

Two or three fine saws in addition.

TUMORS.

Grooved needle.—Case of scalpels.—Two pairs of forceps.—Assalini's forceps.—Four armed needles.—Four sponges.—Two rollers.—Lint.—Cotton wool.—Adhesive plaster. Pocket case.—Chloroform.

In large Tumors of Extremities, &c.

Tourniquet.—Grooved needle, or fine trocar.—Small saws, if osseous.—Two metallic retractors or elevators.—Six or eight armed needles.—Silk for ligatures.

In Mammary Tumors, when large, compress the subclavian artery against the first rib.

BURSÆ.

Long needle with silk.

OPERATION FOR ELEVATING DEPRESSED CRANIAL BONE.

Case of scalpels.—Trephine.—Hey's saw; other small saws.—Elevator.—Forceps.—Ligature silk.—Two rollers.—Four sponges.—Lint.—Adhesive plaster.—Pocket case.

RHINOPLASTIC OPERATION.

Case of scalpels.—Two pairs of forceps.—Four small needles, armed.—Twelve minute needles, also armed.

—Two pieces of cork or sponge for aperture of nostrils.—Lint.—Four sponges.—Adhesive plaster.—Pocket case.—Chloroform.

POLYPUS NASI.

Variety of polypus forceps.—Double canula, with fine wire and silkworm gut.—Sponge.

HARE-LIP.

Two fine scalpels.—Two straight silver needles, with movable steel points.—Strong silk thread, waxed.—Three small needles, armed.—Sponge.—Pocket case.—Chloroform.

RANULA.

A curved needle, armed, with double silk, waxed.

REMOVAL OF TONSILS.

Tonsil knife.—Vulsellum, with scissor handles, or guillotine.

STAPHYLORAPHY.

Case of fine scalpels.—Six curved needles, of half an inch in length, armed.—Forceps; second pair, with one longer arm to hold the soft palate.—Two small and soft sponges, firmly fixed on pencils of wood, for cleansing the palate.—Instrument for reversing the needle.—Reflector.—Lint.—Pocket case.

TRACHEOTOMY.

Case of scalpels.—Two pairs of forceps.—Dr. Hall's trocar.—Chain trocar.—Gum tube for trachea.—Spring dilator.—Tenaculum.—Four small sponges.—Ligature silk.—Adhesive plaster.—Pocket case.—Tube for trachea.

PARACENTESIS THORACIS.

Grooved needle.—Case of scalpels.—Forceps.—Flat trocar, with canula.—Gum catheter.—Adhesive plaster.—Pocket case.—Elastic bandage for chest.—Chloroform.

PARACENTESIS ABDOMINIS.

A moderate-sized trocar.—Fine trocar.—Broad flannel bandage.—Adhesive plaster.—Pocket case.

HERNIA.

Case of scalpels.—Two directors, of varying sizes.—Two pairs of fine forceps.—Tenaculum.—Cooper's hernia knife.—Probe-pointed bistoury.—Scissors.—Ligature silk.—Four armed needles.—Adhesive plaster.—Lint.—Ample quantity of cotton wool.—Two rollers.—Razor.—Pocket case.—Four sponges.—Chloroform.

PHYMOSIS.

Straight-pointed bistoury.—Directors.—Scissors.

HYDROCELE.

Grooved needle.—Small trocar, with canula.—Metal syringe to fit.—Half an ounce of tincture of iodine, for radical cure.

HÆMATOCELE.

Case of scalpels.—Metal syringe.—Sponge.—Pocket case.—Chloroform.

CASTRATION.

Case of scalpels.—Forceps.—Strong silk for spermatic cord.—Fine silk for vessels.—Six armed needles.—Lint.—Pocket case.—Chloroform.

CATHETERISM.

RETENTION OF URINE.

Four silver catheters, from No. 4 to No. 9, inclusive.—Six gum catheters, from No. 3 to No. 9.—Opium suppositories of two or three grains.—Oil.

IN ENLARGED PROSTATE GLAND.

Three metallic and three gum catheters

of about the middle size.—Large prostatic catheter.—One large and long catheter.

EXTRAVASATION OF URINE.

Case of scalpels.—Two or three gum catheters, Nos. 5, 7, and 9.—Sponges.—Pocket case.—Chloroform.

STRICTURE, OR RUPTURED URETHRA.

Case of scalpels.—Three silver catheters.—Two or three gum catheters, Nos. 4, 6, and 8.—Director.—Forceps.—Ligature silk.—Pocket case.—Chloroform.

PUNCTURE OF THE BLADDER.

Moderate-sized trocar with canula.—Gum catheter, of size sufficient to pass through the canula.—Adhesive plaster.—Pocket case.—Chloroform.

FISTULA IN PERINEO.

Three silver, and three gum catheters.—Director.—Razor.—Lint.—Strong silk for retaining catheter.—Pocket case.—Chloroform.

HÆMORRHOIDS.

Double silver canula.—Flexible wire bistoury.—Scissors.—Pocket case.—Chloroform.

FISTULA IN ANO.

Sharp and probe-pointed bistoury director.—Piece of soft wood or rectum bougie, to receive the sharp point of the bistoury.—Eyed probe.—Strong silk.—Blunt-pointed forceps, to catch the thread in the rectum.—Pocket case.—Chloroform.

LITHOTRITY.

Two sounds.—Two silver catheters.—Metal syringe, with stopcock to fit.—Two lithotrites.—Two pairs of long forceps for the urethra.—Oil.—Clean warm water at ninety degrees.

LITHOTOMY.

Rectum evacuated.—Staff grooved.—Garters, or straps.—Razor.—Lithotomy knife.—Three or four pairs of lithotomy forceps.—Large gum catheter.—Metallic syringe to fit.—Common forceps.—Assalini's forceps.—Tenaculum.—Sponges.—Oiled silk.—Pocket case.—Chloroform.

LATERAL CURVATURE.

See page 522.

TALIPES.

A small scalpel, with the blade a little turned up at the point, about eight lines in length, (see page 536.)—Scarpa's shoe.—Roller.—Lint.—Adhesive plaster.—Pocket case.

GUN-SHOT WOUNDS.

Case of scalpels.—Two pairs of forceps.—Probe.—Director.—Bullet forceps.—Hey's saw.—Trephine.—Qu. amputation case.—Linen.—Lint.—Four armed needles.—Ligature silk.—Adhesive plaster.—Sponges.—Chloroform.

CÆSAREAN OPERATION.

Broad bandage, interrupted by silk threads, placed around the chest before operating.—Strong short-bladed scalpels.—Director, with a bulbous point.—Common director.—Pair of scissors, and thread for umbilical cord.—Twelve armed needles.—Four large sponges.—Oil.—Adhesive plaster.—Cotton wool.—Flannel roller.—Flannel, and warm-bath, for child.—Pocket case.—Chloroform.—Oiled silk.

OVARIOTOMY.

Strong scalpels.—Long-toothed forceps, with firm wooden handles.—Large-sized trocar, with canula.—Strong silk for tying cyst, or waxed

twine.—Fine ligature silk.—Four armed needles.—Adhesive plaster. —Lint.—Flannel roller.—Cotton wool.—Pocket case.—Chloroform.

PALPEBRAL TUMORS.

Two fine scalpels.—Scissors.—Forceps.—Tenaculum.—Two fine armed needles.—Lint.—Sponge.—Chloroform.

ECTROPION AND ENTROPION.

Two fine scalpels.—Forceps.—Scissors.—Six fine needles, armed.—Fine silk.—Lint.—Sponge.—Adhesive plaster.—Chloroform.

TRICHIASIS & DISTRICHIASIS.

In operation for.

Two fine scalpels.—Forceps.—Scissors.—Tenaculum.—Four very fine needles and thread.—Lint.—Sponge.—Chloroform.—Piece of horn. See page 594.

ARTIFICIAL PUPIL.

Case, containing, Maunoir's scissors. —Beer's cataract knife.—Sir Wm. Adams' knife.—Broad double-edged needle, or keratome.—Minute forceps.—Tyrrel's hook.—Lint.—Linen.—Ribbon, four feet long.

CATARACT CASE.

EXTRACTION.

Beer's knife modified.—Curette.—Fine curved bistoury.—Fine scissors.—Linen.—Ribbon, four feet in length.

DEPRESSION.

Needle, see page 633.—Linen and ribbon.

SOLUTION.

Needle, see page 635.—Linen and ribbon.

Solution of atropine, or extract of belladonna.

EXTIRPATION OF GLOBE.

Case of scalpels.—Curved bladed knife.—Curved scissors.—Forceps. —Large armed needle.—Tenaculum.—Sponge.—Lint.—Chloroform.

TUMORS IN ORBIT.

Case of scalpels.—Forceps.—Scissors. —Tenaculum.—Sponge.—Lint.—Chloroform.

STRABISMUS.

Case, containing fine forceps.—Scissors.—Blunt hook.—Fine curved bistoury.—Curved director.—Small double hook elevators.—Fine sponge. —Lint.

OPERATIONS ON LACHRYMAL SAC.

Small double-edged scalpel.—Probe. See page 647.—Style or tube.—Sponge.—Lint.—Qu. Chloroform.

INDEX.

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